NATIONAL LIBRARY OF MEDICINE
NLM 00076812 8

ARMY MEDICAL LIBRARY
FOUNDED 1836

WASHINGTON, D.C.

DUE TWO WEEKS FROM LAST DATE

MAR 26 1954

GPO 262058

1565

78th Congress, 1st Session - - - - - House Document No. 266

OHIO RIVER POLLUTION CONTROL

LETTER

FROM

THE ACTING SECRETARY OF WAR

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED MAY 4, 1943, FORWARDING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A SURVEY OF THE OHIO RIVER AND ITS TRIBUTARIES FOR POLLUTION CONTROL, AUTHORIZED BY SECTION 5 OF THE RIVER AND HARBOR ACT APPROVED AUGUST 26, 1937

IN TWO PARTS
(Three Volumes)
PART TWO

REPORT OF THE UNITED STATES PUBLIC HEALTH SERVICE

ARMY MEDICAL LIBRARY
WASHINGTON, D. C. U. S. A.

AUGUST 27, 1943.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with 257 illustrations

U.S. Ohio river committee

OHIO RIVER POLLUTION CONTROL

LETTER

FROM

THE ACTING SECRETARY OF WAR

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED MAY 4, 1943, FORWARDING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A SURVEY OF THE OHIO RIVER AND ITS TRIBUTARIES FOR POLLUTION CONTROL, AUTHORIZED BY SECTION 5 OF THE RIVER AND HARBOR ACT APPROVED AUGUST 26, 1937

IN TWO PARTS
(Three Volumes)

PART TWO

REPORT OF THE UNITED STATES PUBLIC HEALTH SERVICE

A1565X

AUGUST 27, 1943.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with 257 illustrations

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1944

WA
689
U580
1944
pt. 2

CONTENTS

(Part I consists of the report of the Ohio River Committee)

(Part II consists of the report of the United States Public Health Service)

PART II

	Page
Syllabus	147
Introduction	155
Description	160
Sources of pollution	164
Water quality	168
Low-flow regulation	181
Administration of pollution abatement	184
Acid mine drainage studies	191
Introduction to drainage basin studies	200
Main Ohio River	203
Minor tributary basins	257
Allegheny River Basin	301
Monongahela River Basin	355
Beaver River Basin	407
Muskingum River Basin	437
Hocking River Basin	469
Kanawha River Basin	489
Little Kanawha River Basin	523
Big Sandy River Basin	537
Guyandot River Basin	561
Scioto River Basin	575
Miami River Basin	601
Little Miami River Basin	643
Kentucky River Basin	667
Licking River Basin	689
Salt River Basin	707
Wabash River Basin	721
Cumberland River Basin	769
Green River Basin	795
Tennessee River Basin	811

LIST OF TABLES

1. Summary of data on water supply, sources of pollution, and cost estimates of remedial measures — 152
2. Significance of laboratory determinations — 158
3. Industrial wastes — 167
4. Water quality requirements for various uses — 177
5. Summary of laboratory results — 179
6. Monthly distribution of flood damage at Pittsburgh — 183
7. Acid mine drainage loads — 192
8. Costs of mine sealing — 196
9. Damages due to acid mine drainage — 197

LIST OF FIGURES

1. Map—Ohio River Basin, showing principal streams — 147
2. Organization chart and map, showing field offices — 156
3. Map—Location of coal fields — 160
4. Map—Mean annual temperature — 160

415654

	Page
5. Map—Mean annual precipitation	160
6. Chart—Population (1890–1940)	162
7. Map—Urban population (1890–1940)	162
8. Map—Major reservoirs	162
9. Map—Water supplies	164
10. Map—Sources of pollution	164
11. Chart—Progress of sewage treatment	166
12. Map—Suggested industrial waste correction	166
12a. Chart—Relation between monthly average and minimum daily dissolved oxygen results	174
13. Map—Coliform results	180
14. Map—Biochemical oxygen demand results	180
15. Map—Dissolved oxygen results	180
16. Map—Distribution of acid mine drainage	191
17. Chart—Mine sealing performance	194

SUPPLEMENTS TO PART II

(Bound Separately)

A. Collection of data on sources of pollution	847
B. Laboratory, organization, and methods	901
C. Acid mine drainage	973
D. Industrial waste guides	1025
E. Epidemiological studies	1217
F. Biological studies	1275

Fig.-1

GPO-43 O-90035

REPORT UPON SURVEY OF THE OHIO RIVER AND ITS TRIBUTARIES FOR POLLUTION CONTROL

Syllabus

The Ohio River Pollution Survey was directed by section 5 of the River and Harbor Act, approved August 26, 1937, and subsequent authorizations by the Secretary of War, Secretary of the Treasury, and Federal Security Administrator. This report presents information pertaining to sources, amounts, and effects on various water uses of polluting material discharged into the watercourses of the 204,000 square miles of the Ohio River Basin, and includes cost estimates for comprehensive pollution control measures.

The work of this survey has included locating all important sources of pollution and ascertaining the amount of polluting material discharged at each, measuring the present effects of the wastes on the streams by means of physical, chemical, bacteriological and biological examinations, determining the present and prospective uses of the streams, estimating the effects of changes in stream flows and river conditions and of possible future additional pollution, and determining the degree of pollution abatement by treatment, low-flow regulation, or other methods, which seems economically justified in the light of present and prospective stream uses. This has necessitated studies of water quality requirements for various uses, of available techniques for correcting various types of pollution and their cost, of disease outbreaks suspected of being waterborne, and of legal and administrative instruments and methods available for effecting pollution abatement.

Besides furnishing water for more than 7,000,000 persons and for industrial processes, the streams of the Ohio River Basin are used for the disposal of sewage by some 8,500,000 people, and almost two-thirds of this sewage receives no treatment. Industrial wastes with an oxygen demand equivalent to sewage from almost 10,000,000 additional persons enter the streams. Pollution problems are further complicated by the effect of waters containing 1,800,000 tons of acid per year which flow or are pumped from active and abandoned coal mines in the extensive coal fields of the basin.

Many water supplies, both domestic and industrial, suffer from the effects of these polluting substances and outbreaks of intestinal diseases, apparently water-borne, have occurred following periods of low stream flow. Recreation facilities have been damaged. Fish and other aquatic life have been detrimentally affected. Steamboats, barges, other river craft and structures, pumps, pipe lines and condensers exposed to acid stream waters have been attacked.

Although the Ohio Basin, considered as a whole, is one in which water pollution is serious, the intensity of the problem is far from uniform. Many of the streams receive no wastes of consequence while others could be restored to good sanitary condition at a reasonable

cost. Large concentrations of population or of industries and the present need for the development of more economical methods of correction of pollution from certain types of industrial wastes are practical considerations which will delay the attainment of a high degree of stream restoration in a few areas. Continued intensive research to develop better treatment or recovery techniques is essential in certain instances if conditions are to be improved. The results of this survey have made it more than ever apparent that it is neither practicable nor desirable to establish either uniform or permanent standards of water quality applicable to all streams throughout an area as extensive and varied as the Ohio Basin. On the other hand, some degree of treatment of all municipal sewage seems to be a reasonable requirement in an area as highly urbanized and densely populated as the Ohio Basin, even though harmful effects are confined to possible odors, sludge deposits, floating sewage solids, and scum in the immediate vicinity of the outfall.

Low-flow regulation by reservoirs can be used as an important supplement to treatment and other corrective measures in abating sewage and organic industrial waste pollution and in reducing mine acid surges. Proposed and existing flood-control reservoirs in the area above Pittsburgh, those under construction on the Mahoning, New, and Cumberland Rivers, and the proposed reservoir on the Olentangy River above Columbus, Ohio, are among those with outstanding value for pollution control. Others will have minor value. In general, the cost of providing storage exclusively for pollution control is not warranted by the benefits, although this does not hold true in certain instances. If the regulated flow can be made available incidental to some other reservoir use, such as power or flood control, the value of the flow regulation for pollution abatement may be a factor in determining the economic justification of the reservoir project.

There appears to be both a need and a desire for abatement of water pollution in the Ohio Basin. About half of the sewage entering tributary streams, except at Ohio River cities, such as Pittsburgh and Cincinnati, now is being treated. However, a negligible part of the sewage, from Ohio River communities is treated and this stream serves as a source of water supply for more than 1,600,000 people. The provision of sewage treatment facilities at Pittsburgh, Cincinnati, and Louisville, and various measures for the correction of mine acid pollution, principally in the upper Ohio River regions, are outstanding projects in the suggested basin-wide program for pollution abatement.

Salient features of the main Ohio River and the five Ohio River division districts of the United States Engineer Department and their pollution problems are as follows:

Main Ohio River.—A negligible part of the sewage from Ohio River communities is treated and this stream serves as a source of water supply for more than 1,600,000 people. One of the major factors which has delayed waste treatment on the Ohio River while rapid progress was being made elsewhere is the interstate character of the stream. In general, the State agencies concerned with water pollution lack authority over waste discharges to the Ohio River. An attempt is being made to correct this situation by means of an interstate compact, the Ohio River Valley Water Sanitation Compact, which has been approved by the Congress and ratified unconditionally

by four States and with reservations by two others. Ratification by the Pennsylvania Legislature is necessary before the compact can become effective. Since this is the first attempt that has been made to deal with interstate pollution problems in any large area in this manner, ratification by Pennsylvania is highly desirable in order that the compact may become operative and that this method of administrative control may be tested.

Pittsburgh district (Allegheny, Monongahela, and Beaver River Basins).—The tributaries in the Pittsburgh engineer district receive about two-thirds of all the acid mine drainage in the Ohio Basin. Large amounts of untreated sewage from Pittsburgh and its suburbs enter the lower Monongahela and Allegheny Rivers and untreated sewage and industrial wastes from the Youngstown district seriously pollute the Mahoning and Beaver Rivers. Industrial wastes from a pulp mill and tanneries cause severe pollution along the Clarion River in spite of extensive measures taken to reduce the quantity and strength of these wastes. Phenols from byproduct coke plants along the Mahoning cause obnoxious tastes and odors in water supplies from the Beaver River.

Low-flow augmentation by reservoirs on tributaries of the Allegheny and Monongahela will be valuable supplements to mine sealing and sewage treatment programs in abating pollution and the Berlin Reservoir, now under construction on the upper Mahoning, will relieve the shortage of cooling and process water for industrial use in the Youngstown area, in addition to supplementing waste treatment works for pollution control.

Huntington district (Muskingum, Little Kanawha, Hocking, Kanawha, Guyandot, and Big Sandy River Basins).—The principal areas of heavy pollution in the Huntington engineer district are the northern part of the Muskingum Basin and the lower Kanawha River from Charleston downstream. The remaining parts of the Muskingum and Kanawha River Basins as well as the Little Kanawha, Hocking, Guyandot, and Big Sandy Basins and the minor tributaries are relatively clean. A number of the streams are polluted locally by mine drainage and untreated sewage but the communities are not large and the streams generally have sufficient natural alkalinity so that the effects of mine acid are not felt in the larger streams.

The upper Tuscarawas, headwater stream of the Muskingum River Basin, and some of its tributaries are heavily polluted by sewage and industrial wastes although steps have been taken to correct conditions. Waste salts on the upper Tuscarawas make that stream unsuitable as a source of water supply and for some other purposes for many miles. Chemical plants along the Kanawha River in the Charleston area are among the largest sources of pollution in the Ohio Basin. These wastes, together with untreated sewage from the cities in the same area, cause nuisance conditions in the river and serious taste and odor difficulties at water supplies downstream. Low-flow control by the Bluestone Reservoir now under construction on the New River will be of supplementary value in abating organic but not taste and odor pollution from this area.

Cincinnati district (Scioto, Little Miami, Licking, Miami, and Kentucky River Basins).—More than 80 percent of the sewage from communities on tributaries in the Cincinnati engineer district is treated. The most heavily polluted tributary in the district is the

lower Miami River. Two of the larger cities on the lower Miami discharge untreated sewage, but a major part of the pollution load comes from paper mills. Adequate pollution abatement will require research to develop more efficient methods of treating these wastes. Low-flow regulation for pollution abatement does not appear promising since present minimum flows are relatively high, and significant increases in these flows would require large storage capacities at high costs.

In spite of the recently constructed complete treatment plant at Columbus, the Scioto River is still polluted. There are many times when there is practically no dilution for the treatment plant effluent. Low-flow control by the proposed flood-control reservoir on the Olentangy River above Delaware would aid considerably in solving this problem. Strawboard plant wastes pollute the Scioto below Circleville, although the recently completed treatment plant has helped the situation. There is an urgent need for improved methods of treating these wastes and paper mill wastes. The Licking and Little Miami Rivers receive considerable amounts of untreated sewage and industrial wastes near their mouths in the Cincinnati metropolitan area. These should be intercepted and discharged after treatment to the Ohio River. Such a program is under way on the Little Miami. The outstanding sources of pollution in the Kentucky River Basin are distilleries, a number of which need improved waste disposal facilities. In general, the Licking, Kentucky, and Little Miami are relatively clean streams.

Louisville district (*Salt, Green, and Wabash River Basins*).—The Wabash River is the largest stream in the Louisville engineer district and the only one with a major pollution problem. The Salt and Green River Basins are relatively clean although some of the distilleries in the Salt Basin have inadequate waste-disposal facilities.

About three-quarters of the sewage from communities in the Wabash River Basin is treated. The largest municipality discharging untreated sewage is Terre Haute. Industrial wastes, particularly from vegetable canneries and strawboard plants, cause the most serious problems at present. The West Fork of White River is rather heavily polluted by wastes from Indianapolis, Muncie, and Anderson, although all of these communities have sewage-treatment plants. There are no suitable reservoir sites above these cities which could be used for low-flow control. Improvements to the Indianapolis treatment plant are needed to improve conditions in the West Fork.

Nashville district (*Cumberland and Tennessee River Basins*).—More than half of the pollution load in the Cumberland Basin enters the main stream in the vicinity of Nashville, the only large city in the basin. About one-half of the sewage outside of Nashville is treated at present. Under present unregulated flow conditions, secondary treatment would be required at Nashville in order to maintain satisfactory stream conditions. Upon completion of the Wolf Creek Reservoir, now under construction on the upper Cumberland, the minimum flow at Nashville will be sufficient to permit maintenance of satisfactory conditions with only primary treatment.

The Tennessee River Basin is a predominantly rural area which is experiencing a considerable industrial development due in a large degree to the program of the Tennessee Valley Authority. Scant progress has been made toward pollution abatement. The largest

cities and principal industrial centers are Chattanooga, Knoxville, and Asheville, all of which discharge sewage and other wastes without treatment. Most of the other important sources of pollution are on tributary streams in the upper half of the basin. Pulp, paper, chemical, and textile wastes account for the bulk of the industrial waste load.

The program of the Tennessee Valley Authority has increased the low flow of the main stream and some of the tributaries, and further increases will result from reservoirs now under construction and those proposed but, with the exception of Chattanooga and Knoxville, the important sources of pollution are upstream from reservoirs and will not be helped by the increased flow. Additional effort is needed to improve methods now available for treating some of the industrial wastes.

The problem of financing the necessary facilities has always been one of the principal deterrents to pollution abatement. The effectiveness of grants-in-aid and low interest loans in accelerating such work has been proved by the experience of the past 7 years. It seems doubtful that any such rapid progress will continue without aid from either the Federal or the State Governments.

Table 1 summarizes some of the more important facts about the Ohio Basin. The cost estimates of waste-treatment facilities include both interceptors and treatment plants. The estimated capital cost of the suggested program, including a mine sealing program, is approximately $180,000,000 and annual charges for operation, interest, and amortization approximately $18,500,000. Cost estimates are based on average experience from 1928 to 1940. Cost for 1942 would be considerably higher and future costs will probably be subject to further change, depending upon fluctuations in construction costs for this type of work.

TABLE 1.—*Ohio River Basin—Summary of data on population, public water supplies, sewerage, sewage treatment, industrial wastes, costs of existing and suggested waste treatment facilities and mine sealing by basins and States*

[All populations, population equivalents, and costs are in thousands]

	Mileage of confluence with Ohio River	Drainage area, square miles	Population, 1940			Public water supplies				Population served by sewers				Number of sewage treatment plants		
			Urban	Rural	Total	Total, all supplies		Polluted surface supplies		Treatment			Total	Primary	Secondary	Total
						Number	Population served	Number	Population served	None	Primary	Secondary				
BY BASINS																
Main Ohio River			2,570.5	127.2	2,697.7	121	2,172.2	30	1,663.0	2,069.7	6.1	16.4	2,092.2	4	16	20
Minor tributaries		23,780	130.4	1,254.8	1,385.2	94	213.7	9	24.6	57.5	13.9	96.4	167.8	12	30	42
Pittsburgh engineer district:																
Allegheny	981.0	11,730	523.5	713.2	1,236.7	225	1,545.8	21	920.1	755.5	109.0	55.3	919.8	22	19	41
Monongahela	981.0	7,380	585.1	679.6	1,264.7	153	878.2	57	684.3	796.1	45.8	20.3	862.2	13	7	20
Beaver	955.6	3,145	477.3	251.1	728.4	50	554.1	12	430.4	297.3	134.3	84.1	515.7	17	18	35
Huntington engineer district:																
Muskingum	808.8	8,040	398.4	413.6	812.0	94	471.2	4	74.5	137.0	78.7	206.9	422.6	13	18	31
Little Kanawha	796.4	2,320		92.4	92.4	8	10.0	3	2.9	5.4	1.4	3.4	10.2	1	1	2
Hocking	781.7	1,185	48.1	65.5	113.6	16	51.0	0	0	24.4	1.3	22.7	48.4	2	2	4
Kanawha	715.3	12,300	175.5	659.3	834.8	180	326.4	33	151.7	177.0	20.9	28.6	226.5	6	6	12
Guyandot	675.8	1,670	8.2	140.1	148.3	89	61.5	5	12.9	23.9	0	0	23.9	0	0	0
Big Sandy	663.9	4,280	31.2	380.7	411.9	120	137.5	15	44.3	52.4	0	2.6	55.0	0	3	3
Cincinnati engineer district:																
Scioto	624.5	6,510	447.8	291.8	739.6	44	479.7	3	345.5	11.1	43.9	357.6	412.6	15	18	33
Little Miami	516.9	1,755	24.0	111.5	135.5	21	39.1	2	1.5	85.1	8.1	16.5	109.7	3	8	11
Licking	510.8	3,670	27.8	161.5	189.3	17	37.9	5	23.0	14.0	0	11.2	25.2	0	2	2
Miami	489.9	5,385	502.1	328.4	830.5	64	602.1	2	24.5	128.1	89.0	333.4	550.5	10	21	31
Kentucky	435.2	6,940	96.1	385.9	482.0	38	151.0	10	113.3	35.9	1.2	68.2	105.3	3	10	13
Louisville engineer district:																
Salt	351.1	2,890	16.0	123.9	139.9	17	27.1	5	4.3	3.2	1.7	15.4	20.3	1	7	8
Green	196.8	9,220	44.4	400.0	444.4	39	69.9	9	23.4	10.7	29.3	5.0	45.0	8	3	11
Wabash	133.0	33,100	1,198.1	1,310.5	2,508.6	275	1,299.1	30	687.5	297.7	39.1	782.9	1,119.7	10	74	84
Nashville engineer district:																
Cumberland	60.6	18,000	277.7	851.3	1,129.0	92	368.0	16	239.4	173.0	9.3	55.0	237.3	7	10	17
Tennessee	46.5	40,600	631.9	1,859.4	2,491.3	244	871.1	23	394.7	492.9	41.8	56.6	591.3	26	18	44
Total		203,900	8,214.1	10,601.7	18,815.8	2,001	10,366.6	294	5,865.8	5,647.9	674.8	2,238.5	8,561.2	173	291	464

BY STATES															
Alabama	6,810	79.5	310.5	390.0	21	83.7	5	39.7	58.6	4.4	0	63.0	2	0	2
Illinois	11,440	214.3	386.2	600.5	70	232.2	14	103.5	53.1	29.8	120.5	203.4	3	23	26
Indiana	29,135	1,242.0	1,261.4	2,503.4	262	1,379.6	26	744.7	439.8	10.5	713.9	1,164.2	9	68	77
Kentucky	39,375	837.5	1,953.3	2,790.8	232	1,114.4	55	819.3	650.4	49.2	149.4	849.0	22	42	64
New York	1,955	76.4	73.0	149.4	25	119.3	1	24.0	29.5	79.5	1.5	110.5	9	2	11
North Carolina	6,260	67.7	287.0	354.7	55	124.9	1	.2	98.0	1.5	3.5	103.0	3	10	13
Ohio	29,570	2,470.2	1,656.4	4,126.6	301	2,796.2	26	1,433.3	1,379.3	239.0	975.5	2,593.8	55	82	137
Pennsylvania	15,620	1,992.9	1,425.7	3,418.6	355	2,654.2	66	1,630.3	1,827.1	200.3	159.4	2,186.8	36	38	74
Tennessee	33,645	666.9	1,487.3	2,154.2	150	850.8	22	573.3	452.9	24.0	76.7	553.6	19	14	33
Virginia	7,175	62.3	393.1	455.4	84	127.2	5	11.3	44.1	8.6	5.9	58.6	2	3	5
West Virginia	20,610	500.9	1,276.7	1,777.6	435	876.3	73	486.2	609.1	25.9	28.7	663.7	11	8	19
Georgia, Maryland, and Mississippi	2,305	3.5	91.1	94.6	11	7.8	0	0	6.0	2.1	3.5	11.6	2	1	3
Total	203,900	8,214.1	10,601.7	18,815.8	2,001	10,366.6	294	5,865.8	5,647.9	674.8	2,238.5	8,561.2	173	291	46

	Industrial wastes, population equivalent (biochemical oxygen demand)			Total population equivalent (biochemical oxygen demand)		Estimated costs of waste treatment facilities								Estimated capital costs of mine sealing	
	To municipal treatment	Not to municipal treatment	Total	Before treatment	As discharged	Existing municipal		Suggested municipal		Suggested industrial		Total suggested municipal and industrial		Through 1940	To complete program[1] with 1940 restrictions
						Capital	Annual	Capital	Annual	Capital	Annual	Capital	Annual		
BY BASINS															
Main Ohio River		2,392.0	2,392.0	4,484.2	4,468.4	1,080	95	67,910	5,595	3,120	1,115	71,030	6,710	0	0
Minor tributaries	0.9	30.3	31.2	199.0	110.9	3,800	330	2,310	210	280	75	2,590	285	650	480
Pittsburgh engineer district:															
Allegheny	5.2	673.2	678.4	1,598.2	1,514.4	5,460	410	10,020	925	660	230	10,680	1,155	510	1,480
Monongahela	2.0	424.3	426.3	1,288.5	1,254.7	1,500	115	12,140	985	1,110	470	13,250	1,455	1,820	1,600
Beaver	11.8	152.6	164.4	680.1	558.4	4,760	415	4,960	495	1,040	370	6,000	865	60	50
Huntington engineer district:															
Muskingum	40.1	280.5	320.6	743.2	492.2	4,550	440	4,870	395	310	140	5,180	535	[2] 1,450	[2] 110
Little Kanawha				10.2	6.8	190	15	210	20	0	0	210	20	0	0
Hocking	1.4	7.2	8.6	57.0	36.0	840	70	620	55	0	0	620	55	(2)	(2)
Kanawha	11.1	1,479.1	1,490.2	1,716.7	1,675.1	1,300	115	5,000	410	1,270	405	6,270	815	70	120
Guyandot	0	.2	.2	24.1	24.1	0	0	530	45	0	0	530	45	40	10
Big Sandy	0	.4	.4	55.4	53.3	70	10	1,240	110	0	0	1,240	110	70	240
Cincinnati engineer district:															
Scioto	348.6	77.3	425.9	838.5	251.4	12,890	1,090	930	90	370	90	1,300	180	100	40
Little Miami	2.8	57.9	60.7	170.4	149.1	530	55	530	50	50	10	580	60	0	0
Licking	0	3.3	3.3	28.5	18.9	290	30	700	70	10	0	710	70	0	0

See footnotes at end of table.

TABLE 1.—*Ohio River Basin—Summary of data on population, public water supplies, sewerage, sewage treatment, industrial wastes, costs of existing and suggested waste treatment facilities and mine sealing by basins and States*—Continued

[All populations, population equivalents, and costs are in thousands]

	Industrial wastes, population equivalent (biochemical oxygen demand)			Total population equivalent (biochemical oxygen demand)		Estimated costs of waste treatment facilities								Estimated capital costs of mine sealing	
	To municipal treatment	Not to municipal treatment	Total	Before treatment	As discharged	Existing municipal		Suggested municipal		Suggested industrial		Total suggested municipal and industrial		Through 1940	To complete program with 1940 restrictions
						Capital	Annual	Capital	Annual	Capital	Annual	Capital	Annual		
Cincinnati engineer—Continued.															
Miami	166.2	235.3	401.5	952.0	482.7	9,380	745	3,680	320	1,180	340	4,860	660	0	0
Kentucky	32.9	98.5	131.4	236.7	150.4	1,370	155	1,130	100	360	60	1,490	160	60	130
Louisville engineer district:															
Salt	.7	98.2	98.9	119.2	105.3	670	80	210	25	250	45	460	70	0	0
Green	1.4	2.4	3.8	48.8	33.8	450	55	780	80	0	0	780	80	80	310
Wabash	547.5	1,224.5	1,772.0	2,891.7	1,818.9	16,650	1,600	12,830	1,185	1,690	470	14,520	1,655	240	80
Nashville engineer district:															
Cumberland	17.9	240.6	258.5	495.8	430.7	1,660	165	6,870	515	270	50	7,140	565	200	780
Tennessee	5.4	1,300.6	1,306.0	1,897.3	1,832.6	2,750	250	22,870	1,640	1,610	395	24,480	2,035	20	100
Total	1,195.9	8,778.4	9,974.3	18,535.5	15,468.1	70,190	6,240	160,340	13,320	13,580	4,265	173,920	17,585	5,370	5,510
BY STATES															
Alabama	.3	9.1	9.4	72.4	70.7	140	10	1,760	150	10	0	1,770	150	0	0
Illinois	10.1	79.6	89.7	293.1	160.4	3,760	340	2,470	230	20	5	2,490	235	0	0
Indiana	516.9	1,376.8	1,893.7	3,057.9	2,091.0	14,990	1,430	17,910	1,515	1,830	515	19,740	2,030	270	80
Kentucky	49.7	976.0	1,025.7	1,874.7	1,688.8	4,585	500	17,140	1,290	1,010	230	18,150	1,520	340	1,200
New York	5.2	71.9	77.1	187.6	155.6	4,260	310	540	55	90	30	640	85	0	0
North Carolina	.1	509.5	509.6	612.6	609.1	210	15	3,770	290	640	105	4,410	395	0	0
Ohio	580.5	1,922.1	2,502.6	5,096.4	3,688.9	30,380	2,600	35,240	3,205	3,440	840	38,680	4,045	1,940	400
Pennsylvania	13.8	1,156.2	1,170.0	3,356.8	3,152.9	6,940	585	43,050	3,710	2,620	1,245	45,670	4,955	1,490	3,100
Tennessee	8.2	945.8	954.0	1,507.6	1,429.9	2,900	270	21,670	1,475	1,090	305	22,760	1,780	110	420
Virginia	0	35.5	35.5	94.1	87.5	380	35	1,880	170	160	85	2,040	255	0	150
West Virginia	11.1	1,638.9	1,650.0	2,313.7	2,268.5	1,495	130	14,690	1,200	2,570	875	17,160	2,075	1,210	160
Georgia, Maryland, and Mississippi	0	57.0	57.0	68.6	64.8	150	15	310	20	100	30	410	60	10	0
Total	1,195.9	8,778.4	9,974.3	18,535.5	15,468.1	70,190	6,240	160,340	13,320	13,580	4,265	173,920	17,585	5,370	5,510

[1] Areas connected to active ventilation systems and areas where costs exceed \$10 per ton per year not included.
[2] Hocking plus Muskingum costs given under Muskingum.

Introduction

AUTHORIZATION

The investigation of pollution in the Ohio River Basin has been made in compliance with section 5, River and Harbor Act, approved August 26, 1937, which reads in part as follows:

> SEC. 5. That the Secretary of War is hereby authorized and directed to cause a survey to be made of the Ohio River and its tributaries to ascertain what pollutive substances are being deposited, directly or indirectly, therein and the sources and extent of such deposits, and with a view to determining the most feasible method of correcting and eliminating the pollution of these streams.
>
> The survey herein authorized shall include comprehensive investigations and studies of the various problems relating to stream pollution and its prevention and abatement. In making these investigations and studies, and in the development and formulation of corrective plans, the Secretary of War may, with the approval of the Secretary of the Treasury, secure the cooperation and assistance of the Public Health Service, and may allot funds from the appropriation hereinafter designated to pay for such cooperation and assistance. The survey shall be completed as soon as practicable after passage of this act, and the Secretary of War shall report the results thereof to the Congress, together with such recommendations for remedial legislation as he deems advisable.

ORGANIZATION

In approving this section of the act, the President advised the Secretary of War that he desired the appointment of a committee to supervise the survey, the committee to be composed of a representative of the Army Engineer Corps, the Public Health Service, and a non-Government expert to be selected by the other two members. Pursuant to this recommendation, the survey has been made under the general supervision of a committee composed of Brig. Gen. Max C. Tyler, later succeeded by Maj. Gen. T. M. Robins, representing the Corps of Engineers, United States Army; Sanitary Engineer Director R. E. Tarbett, representing the Public Health Service; and Dr. Abel Wolman, Johns Hopkins University, selected as the non-Government expert.

Under this committee, data on sources of pollution and laboratory data have been collected by the United States Public Health Service and hydrometric data have been collected by the United States Engineer Department.

The attached organization chart gives in detail the plan of operation for the conduct of the survey.

Ohio River Pollution Survey

(Total personnel, 96)

TECHNICAL STAFF

Office of stream sanitation (38):
- Cincinnati headquarters (15):
  - Crohurst, H. R., sanitary engineer director (deceased).
  - Tisdale, Ellis S., sanitary engineer (reserve).
  - LeBosquet, M., Jr., senior public health engineer.
  - Hollis, Mark D., passed assistant sanitary engineer.
  - Woodward, Richard L., associate public health engineer.
  - Weibel, Samuel R., associate public health engineer.
  - Eiffert, William T., assistant public health engineer.
  - Palange, Ralph C., assistant sanitary engineer (reserve).
  - Draftsmen (2).
  - Stenographers and clerks (5).

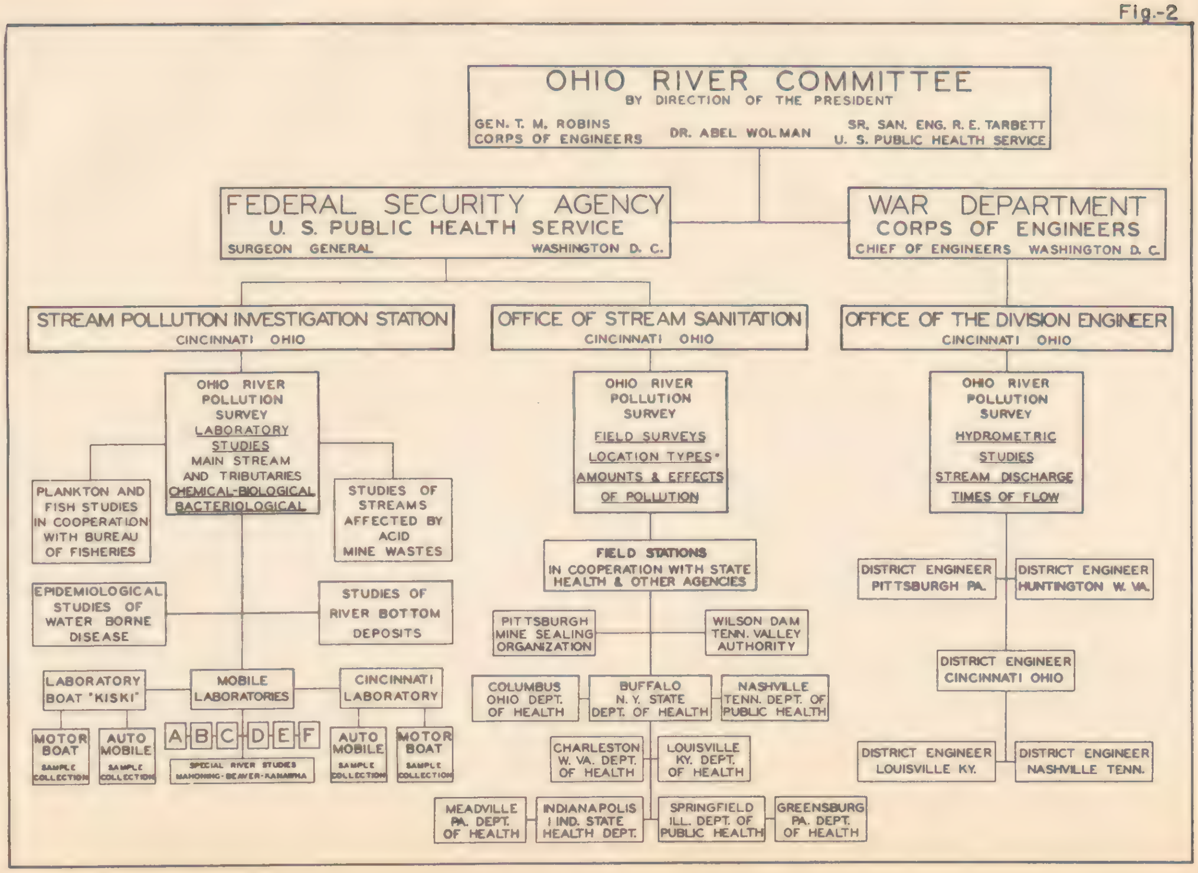
Office of stream sanitation (38)—Continued.
- Field engineers, first year (8):
  - McCallum, Gordon E., associate public health engineer.
  - Poston, Richard F., associate public health engineer.
  - Keatley, Charles R., associate public health engineer.
  - Yaffe, Charles D., assistant public health engineer.
  - Freeman, Archie B., assistant public health engineer.
  - Reed, George D., assistant public health engineer.
  - Solander, Arvo A., assistant public health engineer.
  - Bourne, H. Gardner, Jr., assistant chemical engineer.
- Additional field engineers, second year (15):
  - Haney, Paul D., assistant sanitary engineer (reserve).
  - Seufer, Paul E., assistant sanitary engineer (reserve).
  - Spencer, Charles C., assistant sanitary engineer (reserve).
  - Pearl, Emanuel H., assistant public health engineer.
  - Flanagan, Joseph E., Jr., assistant sanitary engineer (reserve).
  - Johnson, Ralph J., assistant sanitary engineer (reserve).
  - Porges, Ralph, assistant sanitary engineer (reserve).
  - McKinstry, Edward N., assistant public health engineer.
  - Murray, William C., assistant public health engineer.
  - Clark, Sterling M., assistant sanitary engineer (reserve).
  - Joseph, Edwin B., assistant sanitary engineer (reserve).
  - Okun, Daniel A., assistant sanitary engineer (reserve).
  - Raneri, Ray, assistant sanitary engineer (reserve).
  - Rostenbach, Royal E., assistant chemical engineer.
  - Terrill, James G., Jr., assistant sanitary engineer (reserve).

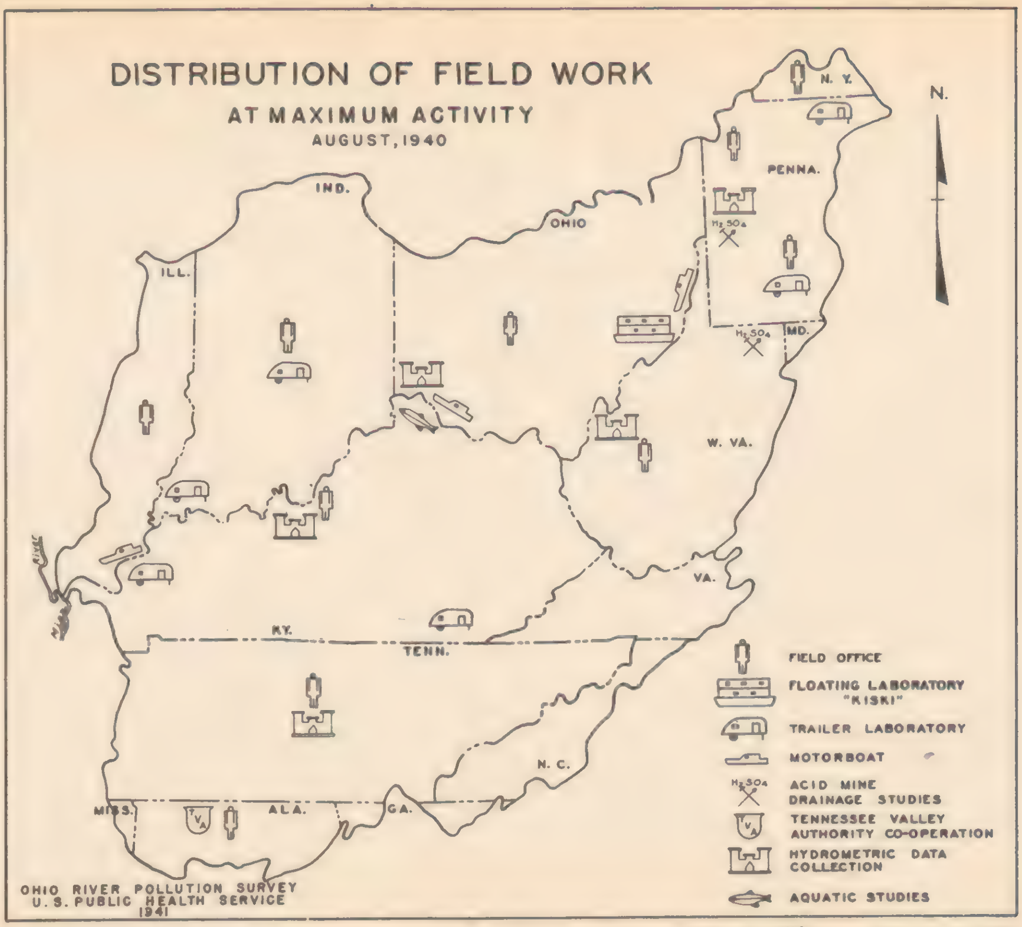
Stream pollution investigations station (58):
- Cincinnati headquarters (21):
  - Hoskins, J. K., sanitary engineer director succeeded by Hasseltine H. E., medical director.
  - Streeter, H. W., sanitary engineer director.
  - Forsbeck, Filip C., surgeon.[1]
  - Wheeler, Ralph C., surgeon (reserve).
  - Brinley, Floyd J., associate biologist.
  - Carnahan, Charles T., public health engineer.
  - DeMartini, Frank E., associate public health engineer.
  - Burns, William E., junior bacteriologist.
  - Ettinger, Morris B., assistant sanitary chemist.
  - Katzin, Leonard I., junior aquatic biologist.
  - Chambers, Cecil W., junior sanitary bacteriologist.
  - Draftsman (1).
  - Statistical clerks (4).
  - Laboratory attendants (4).
  - Sample collector (1).
  - Motorboat operator (1).
- Field laboratories (37):
  - Monroe, Stanley G., associate public health engineer.
  - Levine, Benjamin S., bacteriologist.
  - Chapman, Charles R., passed assistant sanitary engineer (reserve).
  - Fittro, Louis L., assistant sanitary engineer (reserve).
  - Kass, Edwin A., assistant sanitary engineer (reserve).
  - McNair, John C., assistant chemical engineer.
  - Walker, William W., assistant sanitary chemist.
  - Cohen, Stuart, junior chemist.
  - Megregian, Stephen, junior chemist.
  - Middleton, Francis M., junior chemist.
  - Norris, Francis I., junior chemist.
  - Pettijohn, O. Glenn, junior chemist.
  - Snider, Ross A., junior chemist.
  - Lucht, Robert A., junior chemical engineer.
  - Laboratory attendants (9).
  - Sample collectors (9).
  - Shipkeepers (3).
  - Motorboat operators (2).

[1] Deceased.

NOTE.—Official designations apply to the last day of each person's connection with the Ohio River Pollution Survey.

Fig.-2





(Face p. 156) GPO-43 O-90035

REPORT

In presenting and discussing the data collected, this general section is followed by summaries covering the main Ohio River, minor tributaries, and the individual major tributaries. Each summary follows a generally uniform pattern. A number of supplements of general interest on various phases of the work are bound separately.

SURVEY METHODS

The data collected by the Ohio River Pollution Survey comprises three principal types of information:

1. Data on sources of pollution.
2. Laboratory data.
3. Hydrometric data.

Data on sources of pollution were obtained by engineers working at, and out of, 11 field stations maintained for varying periods of time in the offices of State health departments and of the Tennessee Valley Authority. Surveys were made of some 3,700 municipalities and 1,800 industrial plants.

Special studies of industrial wastes were made in cooperation with the cities of Cincinnati and Louisville, the State of West Virginia and the Tennessee Valley Authority. These studies were of value, not only in showing the character and amount of wastes discharged at the plants studied, but also in estimating the effect of wastes from similar plants elsewhere in the basin where less detailed information was available. A special field unit surveyed the acid mine drainage problem and determined the amount and distribution of this type of waste.

Correlated work included the preparation of Industrial Waste Guides containing information on industrial plant processes and practices, the quantities and strength of wastes for representative plants, waste treatment and recovery practices and their effectiveness in reducing pollution; an investigation of pollution abatement laws in the various States, their administration, and effectiveness; a study of the cost of construction and operation of waste-treatment plants both for municipal and industrial wastes; a study of damages caused by water pollution; an investigation of soil erosion and its relation to water pollution; studies of population distribution and trends, of the physiography, climate, cultural and economic background of the basin as it might affect future pollution or abatement.

The major part of the laboratory data was obtained by physical, chemical, and bacteriological tests on samples of water from some 2,000 points on streams in the Ohio River Basin. The sampling points were located so as to give a representative picture of the quality of the streams of the basin and the effect of waste discharges on water quality. More than 71,000 samples were examined and some 131,000 tests made. Laboratories were located at the United States Public Health Service Stream Pollution Investigations Station at Cincinnati, the quarterboat *Kiski*, loaned by the United States Engineer Department and equipped for laboratory work, and at 6 mobile laboratories in automobile trailers.[1] The *Kiski* and the trailer laboratories were

[1] Public Health Reports, April 11, 1941, pp. 754–760 (Reprint No. 2259).

moved from place to place as the work required and samples collected and brought to the laboratories by automobile and motorboat.

Laboratory work was begun in 1939 and the area from the mouth of the Kanawha River to the mouth of the Kentucky River was surveyed during that year. The survey, which had originally been planned to continue for 3 years, was then shortened to 2 years because of the defense emergency. As a result the data on the upper and lower thirds of the basin are less extensive than was originally planned.

The attached table shows the routine laboratory examinations which were made and a brief explanation of each. Special laboratory tests made from time to time on selected samples have included nitrites, nitrates, acidity to phenolphthalein (hot and cold), total hardness and phenol content.

TABLE 2.—*Ohio Basin: Significance of various physical, chemical, and bacteriological tests used in Ohio River pollution survey*

Test	Explanation
	PHYSICAL AND CHEMICAL TESTS
1. Temperature	Governs the solubility of oxygen and influences rates of purification.
2. Turbidity	An index of the density of silt or other suspended matter carried by the stream.
3. pH	Or hydrogen-ion concentration, indicates the relative acidity or alkalinity of a water.
4. Alkalinity	Represents the content of carbonates, bicarbonates, hydroxides, and occasionally borates, silicates, and phosphates.
5. Total and volatile suspended matter.[1]	Represents the concentration of suspended matter, in terms of dry solids, and is a rough index of the organic waste material present.
6. Dissolved oxygen	Essential to natural purification of streams and the maintenance of aquatic life, is drawn upon to support biochemical oxidation of organic waste and is replaced by absorption from the atmosphere and the photosynthetic action of some water plants including algae. A deficiency in dissolved oxygen below the saturation level indicates the presence of polluting organic substances which are absorbing oxygen from the stream water. The degree of this deficiency is a measure of the deoxygenating effect of the polluting matter and hence an index of the degree of pollution in a particular stream zone.
7. Five-day biochemical oxygen demand at 20° C.	Indicates the amount of dissolved oxygen which may be expected to be asborbed from the stream water in 5 days at 20° C. to support the biochemical oxidation of the organic pollution carried by the stream at the point of sampling.
	BACTERIOLOGICAL TESTS
8. Total count on agar in 24 hours at 37° C.[1]	Considered in conjunction with the coliform bacteria the plate count is of value both as an indication of pollution and as a rough measure of natural stream purification.
9. Coliform bacteria (determined by standard fermentation tube test at 37° C.).	Expressed as "most probable number" (M. P. N.). This test is the most delicate and specific test for pollution by sewage as it shows the approximate density of a group of bacteria which are always present in large numbers in sewage and are relatively few in number in other stream pollutants. Coliform bacteria are normal inhabitants of the intestines of warm-blooded animals and are discharged in large numbers in human feces, which constitute the principal source of these bacteria in sewage.
10. Coliform bacteria (determined by direct plate count on brilliant green lactose bile at 37° C.).	Utilizes the plate count method, rather than the fermentation tube method, for the determination of coliform bacteria using a culture medium selective for this type of organism.

[1] Discontinued as a routine test at the end of 1939.

Recognizing the importance of standard techniques to secure comparable results from the several laboratories, systematic and thorough instruction in standard methods of water analysis, covering a period of from 4 to 6 weeks, was given to all laboratory personnel, at the Cincinnati laboratory, prior to detail in the field. Frequent checks were made to observe methods and results and to correct any inconsistencies in technique. Memoranda to personnel covering laboratory methods are included in a supplement to this report.

In addition to the routine stream-sampling program, a number of special investigations were made. These include an investigation of water quality requirements for various water uses; an epidemiological study of outbreaks of intestinal diseases suspected of being water-borne; a biological study of the effects of pollution on plankton and higher forms of aquatic life, notably fish; a controlled study to measure the effect of complete and partial mine sealing on streams; studies of tastes and odors in water supplies along the lower Kanawha, the Mahoning and Beaver Rivers, in cooperation with the State Health Departments of Ohio, Pennsylvania, and West Virginia; and studies of mud deposits behind the navigation dams on the main Ohio River.

All hydrometric data were obtained by the division engineer's office, United States Engineer Department, Ohio River Division, with the assistance of the five district engineer offices in the basin. In addition to the operation of the regular stream-gaging stations, the work included the measurement or estimation of stream flows at each sampling station on the days when samples were collected; compilation of monthly flows during the summer months for the entire period of record at selected stations and preparation of frequency curves of low flows; studies of water velocities and times of flow in the main Ohio River and certain tributaries; and studies of possible modification of flow conditions by proposed flood-control reservoirs.

ACKNOWLEDGEMENTS

The various State health departments of the Ohio River Basin have rendered invaluable help to this survey by making available the results of their years of experience in pollution abatement work, by furnishing office space to field engineers, and by assisting in many other ways. The State of Tennessee, in addition, furnished results of stream-sampling programs. The Health and Safety Section of the Tennessee Valley Authority has aided similarly by furnishing office space, and the results of its investigations of the streams and waste discharges in the Tennessee River Basin. Municipal officials, water and sewage treatment plant operators, and industrial officials have aided by furnishing data on waste discharges and plant operation. In a number of instances municipal officials have furnished water and electric power for trailer laboratory units without charge. The cities of Cincinnati and Louisville have assisted by making available the results of consulting engineers' studies of their waste treatment problems. The city of Dayton, Ohio, furnished results of stream sampling conducted by its sewage treatment plant laboratory. Among the Federal agencies that have assisted are the Fish and Wildlife Service, which made physiological examinations of fish specimens; the United States Geological Survey, which furnished maps and advance data on stream flow; the Bureau of the Census, which furnished advance data on population; the United States Bureau of Mines, which aided in the study of acid mine drainage; the Soil Conservation Service, which furnished data on the extent and severity of soil erosion; and the National Resources Planning Board, which made available the results of its studies of the Ohio River Basin. In the preparation and criticism of Industrial Waste Guides, assistance has been received from State, Federal, municipal, and industrial officials throughout the

country and from consulting engineers, equipment manufacturers, trade associations, universities, and technical schools.

Description

The Ohio River Basin (fig. 1) includes 203,900 square miles, about 7 percent of the continental United States. It extends into 14 States. The river originates at the confluence of the Allegheny and Monongahela Rivers in Pittsburgh and flows generally southwest for a distance of 981 miles to its confluence with the Mississippi River at Cairo, Ill., It is the second largest tributary of the Mississippi but the largest contributor to its flow.

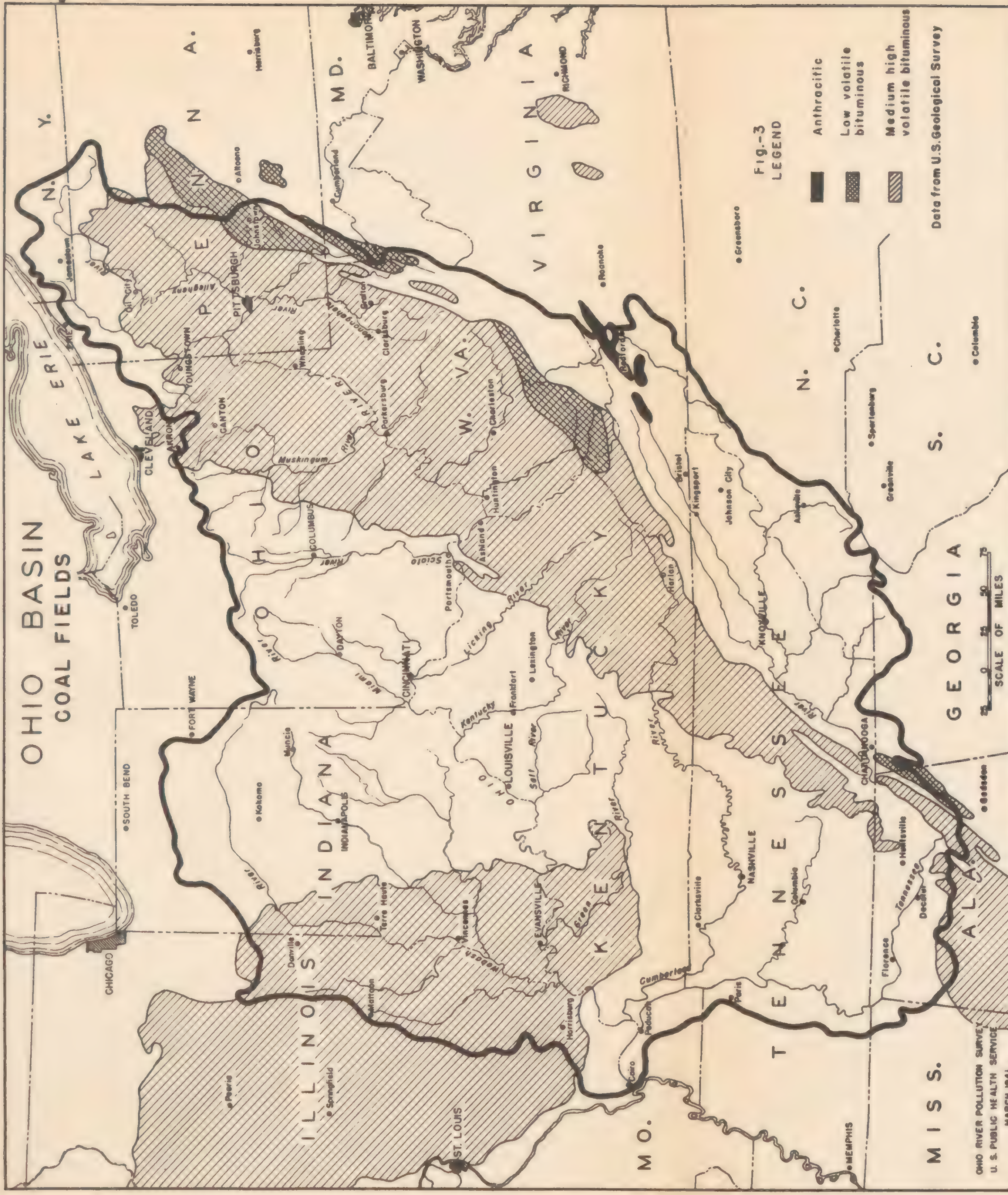
Besides the Allegheny and Monongahela Rivers, the larger tributaries are the Beaver, Muskingum, Hocking, Scioto, Little Miami, Miami, and Wabash Rivers entering from the north, and the Little Kanawha, Kanawha, Guyandot, Big Sandy, Licking, Kentucky, Salt, Green, Cumberland, and Tennessee Rivers entering from the south. The various tributary basins are outlined on figure 1 and their drainage areas are shown in table 1.

Topography.—Three major physical divisions characterize the Ohio Basin, the Appalachian Highlands in the east, the Interior Plateau in the southwest and the Interior Plains in the northwest. The Applachian Highlands include practically all of the area draining to the Ohio above the Scioto River as well as the headwaters of the Licking, Kentucky, and Cumberland Rivers and the upper half of the Tennessee River. The land is generally hilly or mountainous with steep slopes and narrow stream valleys. The Interior Plateau includes the area south of the Ohio River and west of the mountains and small parts of southern Ohio, Indiana, and Illinois. The hills in this section are lower and less steep than in the highlands and the stream valleys generally wider. The well-known bluegrass section of Kentucky and the Nashville Basin in Tennessee are the most highly developed parts of the Interior Plateau. The Interior Plains include most of the land north of the Ohio River and west of the highlands. The land is level or gently rolling. Practically all of this section has been covered by glaciers and most of the land is fertile and well suited to agriculture. It is the principal farming section of the Ohio Basin and constitutes the eastern third of the Corn Belt.

Geology.—Limestones and shales are the most common bedrocks of the basin. The principal mineral resource is coal which underlies much of the highland section. (See fig. 3.) Coal is also mined in western Indiana, Kentucky, and in Illinois. The Ohio Basin accounts for about 80 percent of the total national coal production. Petroleum and natural gas has been developed in the Appalachian fields of New York, Pennsylvania, Ohio, West Virginia, Kentucky, and Tennessee, in western Ohio, northeastern and southwestern Indiana; and in central and southern Illinois. In recent years the development of the southern Illinois oil field has made that State the second largest oil-producing State in the country. Other minerals of commercial importance include building stone, phosphate rock, various types of clay, sand, gravel, rock asphalt, and fluorspar.

Climate.—The climate of the basin is temperate and continental and well suited to various types of agriculture. Mean annual temperatures vary from 40°F. in the north to over 60°F. in the south. (See fig. 4.)

Fig. -3



OHIO BASIN
COAL FIELDS
Fig.-3
LEGEND
Anthracitic
Low volatile bituminous
Medium high volatile bituminous
Data from U.S. Geological Survey
SCALE OF MILES
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
MARCH 1941
LAKE ERIE
OHIO
INDIANA
ILLINOIS
KENTUCKY
TENNESSEE
W. VA.
VIRGINIA
PENNA.
N. Y.
MD.
N. C.
S. C.
GEORGIA
ALA.
MISS.
MO.
PITTSBURGH
CLEVELAND
CINCINNATI
LOUISVILLE
COLUMBUS
INDIANAPOLIS
EVANSVILLE
NASHVILLE
KNOXVILLE
CHATTANOOGA
ST. LOUIS
CHICAGO
WASHINGTON
BALTIMORE
RICHMOND
MEMPHIS

Fig. 4

OHIO BASIN
MEAN ANNUAL TEMPERATURE
LAKE ERIE
OHIO
INDIANA
ILLINOIS
KENTUCKY
TENNESSEE
W. VA.
VIRGINIA
PENNA.
MD.
N. CAR.
S. CAR.
GEORGIA
ALA.
MISS.
MO.
CHICAGO
TOLEDO
CLEVELAND
PITTSBURGH
COLUMBUS
CINCINNATI
LOUISVILLE
EVANSVILLE
INDIANAPOLIS
FORT WAYNE
SOUTH BEND
ST. LOUIS
NASHVILLE
CHATTANOOGA
KNOXVILLE
BALTIMORE
WASHINGTON
RICHMOND
MEMPHIS
SCALE OF MILES
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
MARCH 1941

Fig. 5

OHIO BASIN
MEAN ANNUAL PRECIPITATION
SCALE OF MILES
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
MARCH 1941

Extremes of −35° F. and over 100° F. have been recorded. Mean annual rainfall varies from about 36 inches in the north to 60 inches in the southeast. (See fig. 5.)

Run-off.—On an average about one-third to one-half of the rainfall appears as stream flow but this is subject to extreme variations. The flow of the Ohio River at the mouth has varied from as little as 20,000 cubic feet per second to as much as 1,850,000 cubic feet per second, with the average being about 250,000 cubic feet per second. The winter and early spring months are usually the period of high run-off. Major Ohio River floods have almost always occurred between January and the middle of April. The streams usually fall with the advent of the growing season. May and June are usually months of moderately high flow and the low-flow season includes the months from July through October or November. The minimum flows usually occur in September or October.

The 10 years from 1930 to 1939 included a number of notably dry years. The summer and fall months of 1930, 1932, 1934, 1936, and 1939 were among the driest in various parts of the basin. During 1930 the drought was particularly severe and general. The Ohio River and most of its tributaries experienced their lowest flows of record during the late summer and early fall months of 1930. The drought continued throughout much of the winter and into the early months of 1931.

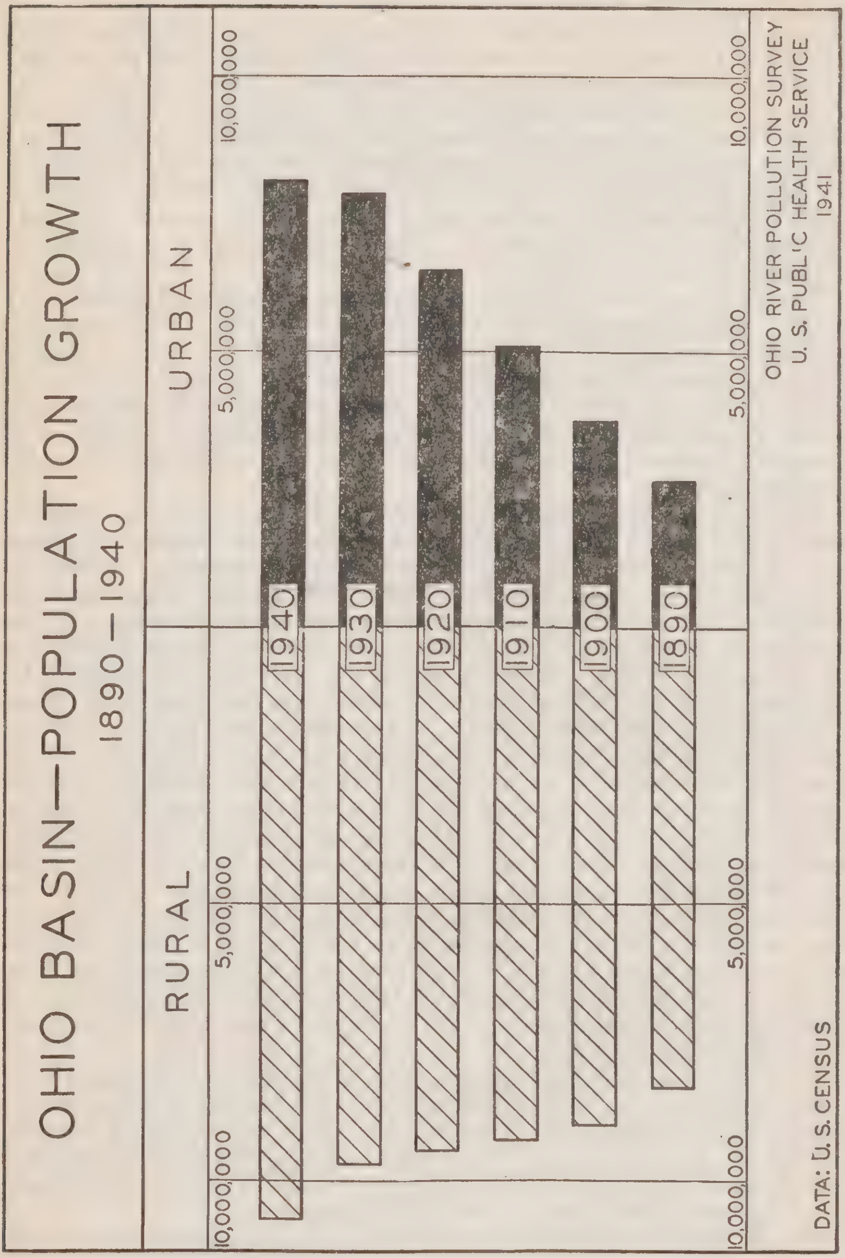
Population.—The population of the Ohio Basin in 1940 was approximately 18,800,000, of which about 44 percent was classified as urban and 56 percent as rural. This represents a population density of more than twice the national average. The basin is somewhat less urbanized than the Nation as a whole where about 56 percent of the population is urban. Table 1 shows the distribution of population by basins and States. Figure 6 shows the increase in population for the years 1890 to 1940, and figure 7 shows the distribution of urban population for the same years. The northern and eastern parts of the basin are more densely populated and more highly urbanized than the southern and western parts but in recent years the rate of growth has been more rapid in the Southern States than in the north.

Navigation.—The Ohio River has been canalized, 46 locks and dams now providing a 9-foot channel at low water. Most of these dams are movable, that is, when not needed during periods of high flow they are dropped to the bottom of the river and boats can pass over them without going through the locks. Four of the dams are fixed and boats must use the locks at all times. These four are the Emsworth, Dashield's and Montgomery Island Dams at the upper end of the river near Pittsburgh and the Gallipolis Dam below the mouth of the Kanawha River.

In addition to the main stream most of the larger tributaries have been canalized for varying distances. Almost 2,000 miles of the Allegheny, Monongahela, Muskingum, Little Kanawha, Kanawha, Big Sandy, and its tributaries (Tug Fork and Levisa Fork), Kentucky, Green, and its tributaries (Barren and Rough Rivers), Cumberland, and Tennessee have been improved for navigation.

The facilities on most of these streams are not extensively used but the Monongahela River is one of the most heavily traveled inland waterways in the world and the Allegheny also carries a large amount of freight in the vicinity of Pittsburgh.

Fig. 6


OHIO BASIN—POPULATION GROWTH
1890—1940
URBAN
RURAL
10,000,000
5,000,000
5,000,000
10,000,000
1940
1930
1920
1910
1900
1890
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941
DATA: U. S. CENSUS

OHIO BASIN—URBAN POPULATION 1890-1940
INCORPORATED PLACES OF 2500 OR MORE

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

DATA: U. S. CENSUS

GPO-43 0-90035

RESERVOIRS COMPLETED OR UNDER CONSTRUCTION — LEGEND

No.	Name	Major Purposes	Ownership	Capacity Acre-Feet
1	Tionesta	F	F	125,600
2	Piney	P	P	28,200
3	Mahoning Cr.	F	F	69,500
4	Crooked Cr.	F	F	89,500
5	Loyalhanna	F	F	93,500
6	Quemahoning	I	P	31,800
7	Youghiogheny	FA	F	249,000
8	Deep Cr.	P	P	106,000
9	Lake Lynn	P	P	72,300
10	Tygart	FN	F	278,800
11	Pymatuning	FIA	S	197,000
12	Meander Cr.	M	D	32,400
13	Milton	IA	M	23,000
14	Berlin	FIA	F	71,000
15	Atwood	F	F	49,700
16	Beech City	F	F	71,700
17	Bolivar	F	F	149,600
18	Charles Mill	F	F	88,000
19	Clendenin	F	F	54,000
20	Dover	F	F	203,000
21	Leesville	F	F	37,400
22	Mohawk	F	F	285,000
23	Mohicanville	F	F	102,000
24	Piedmont	F	F	65,000
25	Pleasant Hill	F	F	87,700
26	Senecaville	F	F	88,500
27	Tappan	F	F	61,600
28	Wills Cr.	F	F	196,000
29	Bluestone	FP	F	609,400
30	Claytor	P	P	225,000
31	O'Shaughnessy	M	M	16,400
32	Germantown	F	D	106,000
33	Englewood	F	D	312,000
34	Taylorsville	F	D	186,000
35	Huffman	F	D	167,000
36	Loramie	F	D	70,000
37	Dix	P	P	300,000
38	Wolf Cr.	FP	F	5,782,000
39	Dale Hollow	FP	F	1,639,000
40	Center Hill	FP	F	2,032,000
41	Great Falls	P	F	54,500
42	Kentucky	NFP	F	6,100,000
43	Pickwick Landing	NFP	F	1,091,000
44	Wilson	NP	F	535,000
45	Wheeler	NFP	F	1,150,000
46	Guntersville	NFP	F	1,018,700
47	Hales Bar	NP	F	128,800
48	Chickamauga	NFP	F	705,000
49	Watts Bar	NFP	F	1,132,000
50	Ft. Loudon	NFP	F	365,500
51	Norris	FP	F	2,567,000
52	Apalachia	P	F	50,000
53	Hiwassee No. I	FP	F	438,000
54	Ocoee	P	F	76,600
55	Blue Ridge	P	F	197,500
56	Nottely	P	F	190,000
57	Chatuge	P	F	240,000
58	Calderwood	P	P	34,000
59	Cheoah	P	P	31,000
60	Fontana	FP	F	1,500,000

Continued

No.	Name	Major Purposes	Ownership	Capacity Acre-Feet
61	Santeetlah	P	P	156,000
62	Nantahala	P	P	140,000
63	Glenville	P	P	71,000
64	Cherokee	P	F	1,640,000
65	S. Holston	P	F	680,000
66	Watauga	P	F	627,000
67	Douglas	P	F	1,260,000
68	Waterville	P	P	25,000
69	Nolichucky	P	P	

LEGEND

Major Purposes	Ownership
F — Flood Control	F — Federal
P — Power	S — State
M — Municipal W.S.	M — Municipal
I — Industrial W.S.	D — Public District
N — Navigation	P — Private
A — Pollution Abatement	

PROPOSED FLOOD-CONTROL AND MULTIPLE-PURPOSE RESERVOIRS IN OHIO VALLEY FLOOD CONTROL PLAN — LEGEND

No.	Name	No.	Name
70	Allegheny	97	Delaware
71	French Creek	98	Big Darby
72	Red Bank Creek	99	Deer Creek
73	Conemaugh	100	Paint Creek
74	West Fork	101	Rocky Fork
75	Shenango	102	Caesar Creek
76	Mosquito Creek	103	East Fork
77	Eagle Creek	104	Falmouth
78	Millersburg	105	Cave Run
79	Frazeysburg	106	Metamora
80	Dillon	107	Brookville
81	Burnsville	108	Buckhorn
82	Steer Cr.	109	Booneville
83	West Fork	110	Jessamine Creek
84	Logan	111	Rough River
85	Poca	112	Mining City
86	Birch	113	Nolin River
87	Clendenin	114	No. 2 Barren
88	Summersville	115	No. 2 Green
89	Big Bend	116	Mansfield
90	Moores Ferry	117	Cagles Mill
91	Mud River	118	Spencer
92	East Lynn	119	Shoals
93	Dewey	120	Wolf Creek
94	Fishtrap	121	Rossview
95	Clintwood	122	Three Islands
96	Haysi	123	Stewarts Ferry

FIG.-8
OHIO BASIN
MAJOR RESERVOIRS

Flood control.—The acute need for flood control on the Ohio River and its tributaries was brought to national attention by the disastrous floods of 1936 and 1937. Prior to that time a number of flood-control projects had been initiated locally, notably those of the Miami and Muskingum Conservancy Districts. The Tennessee Valley Authority and the United States Engineer Department also had constructed some reservoirs and other works for flood control. Following the floods of 1936 and 1937 the Congress authorized the construction of a comprehensive system of reservoirs on Ohio River tributaries and numerous levees and walls for flood protection. Figure 8 shows the location of existing flood-control reservoirs, those under construction and projects being studied. Because major floods usually occur during the winter and early spring, it may be possible to use some of the storage capacity at a number of these reservoirs for low-flow regulation during the summer and early fall months.

Hydroelectric power.—The largest hydroelectric developments in the basin are on the Tennessee River and its tributaries. The Kanawha and New Rivers also are the sites of several power projects. Others are on the Ohio River at Louisville, the Clarion River, a tributary of the Allegheny, the Youghiogheny, and Cheat Rivers, tributaries of the Monongahela, Dix River, a tributary of the Kentucky and the Tippecanoe River and East Fork of White River, tributaries of the Wabash. Two large flood-control reservoirs with excellent power possibilities are under construction at present. These are the Bluestone Reservoir on the New River and the Wolf Creek Reservoir on the Cumberland.

The power facilities of the Tennessee Valley Authority are being expanded rapidly and a number of new projects are under construction. The installed capacity of the entire system is approaching 1,500,000 kilowatts.

Low-flow control.—Pymatuning Reservoir on the Shenango River and Milton Reservoir on the Mahoning River, both tributaries of the Beaver, are the outstanding examples of projects built primarily for low-flow control. Both of these streams are used as sources of industrial water supply by the steel industry and the reservoirs were built to relieve the acute shortage which occurred almost every summer. The Tygart River Reservoir, a multiple-purpose project on a tributary of the Monongahela, was built by the United States Engineer Department to insure an adequate flow for the maintenance of navigation on the Monongahela in addition to providing flood control.

Recreation.—An increasing demand for water recreational facilities has been apparent in recent years. The extensive use of the recently completed reservoirs of the Tennessee Valley Authority and the Muskingum Conservancy District, as well as other bodies of water in the Ohio Basin indicates the need for such recreational areas. Many of the streams also are used by large numbers of people for fishing, boating, and swimming in spite of pollution which often makes swimming unsafe.

Water supplies.—Of the 2,000 public water supplies in the basin, 634 serving more than 7,000,000 people are from surface sources. Many of these surface water supplies are from unpolluted streams or from impounding reservoirs which collect the run-off from relatively small rural areas but 294 supplies, including most of the larger ones, are from streams or reservoirs subject to some sewage pollution. These

supplies serve more than 5,800,000 people. Practically all of these supplies are filtered and chlorinated and a number of them are so highly polluted that special treatment has been found necessary in order to produce a satisfactory finished water. Even after careful and complete treatment, many of the supplies are unpalatable because of obnoxious tastes which cannot be completely removed by normal treatment processes. Table 1 shows the number of supplies and the population served and figure 9 shows the location and size of water supplies.

Industrial water demands exceed in quantity the demands for the municipal supplies. Steel, chemical, textile and paper plants, distilleries, and railroads are among the largest water users and although bacterial quality is seldom of great importance except in the preparation of food products many of the industries require water of special and uniform chemical quality.

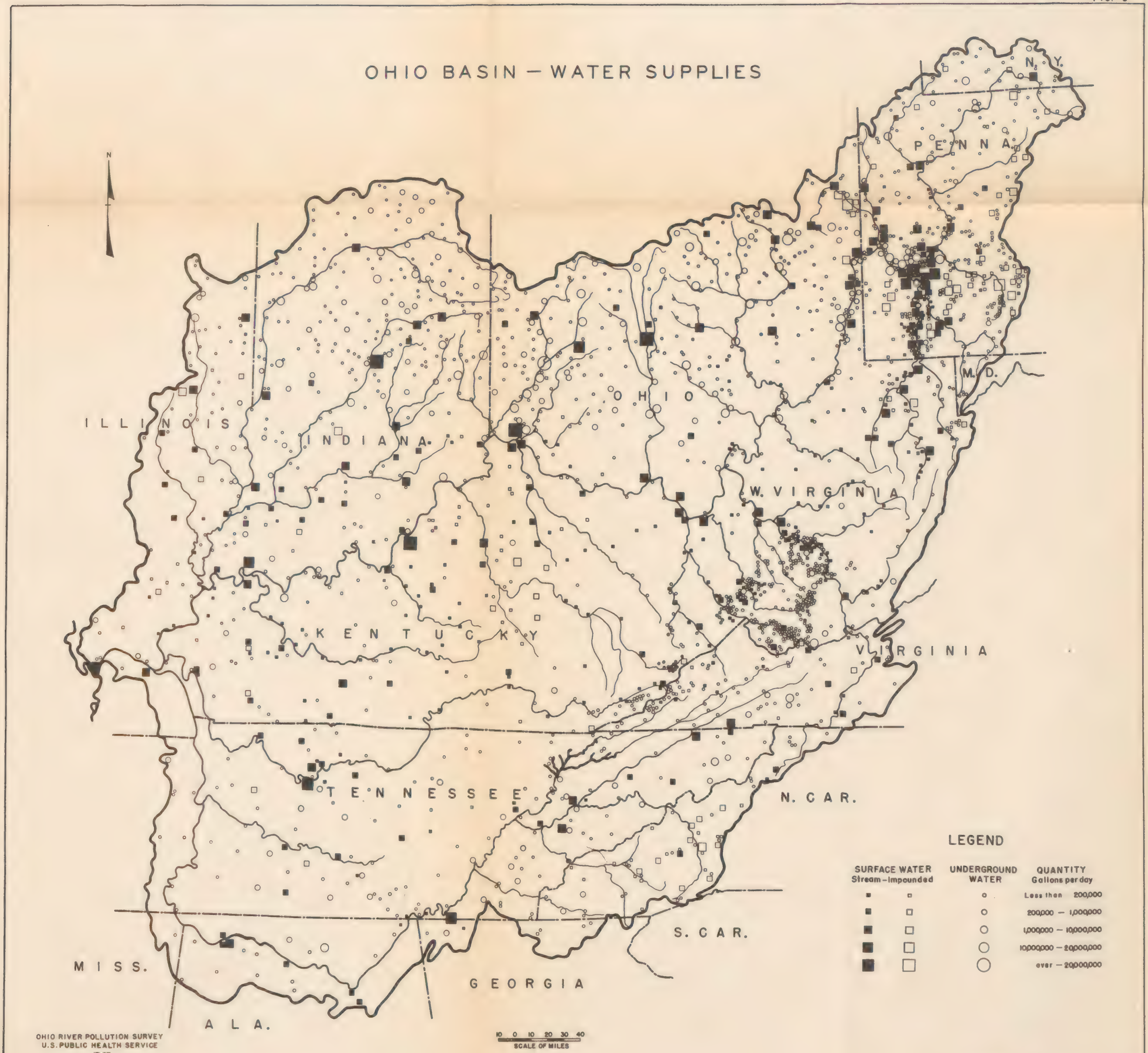
Sources of Pollution

SEWAGE

About 940,000,000 gallons of sewage enter the streams of the Ohio Basin each day. About one-third is treated to reduce its objectionable characteristics and the remainder is discharged untreated. Data on sewerage and sewage treatment are shown in table 1. Figure 10 shows the location of the principal sources of organic wastes including both sewage and industrial wastes.

Techniques for the removal or oxidation of the organic matter and for the destruction of bacteria in sewage are well developed and it is possible to achieve almost any desired degree of purity of the effluent from a sewage-treatment plant. The most common yardsticks for measuring the efficiency of treatment are removal of biochemical oxygen demand and suspended solids. The most common types of sewage-treatment plants remove from 35 to 90 percent of the biochemical oxygen demand. Their efficiency in bacterial removal is of the same order of magnitude. So-called "primary" treatment plants reduce the pollution load by about 35 percent on an average. "Secondary" or "complete" treatment plants usually reduce the pollution load by about 85 percent although there are a number of plants which average from 90 to 95 percent removal of biochemical oxygen demand. Other types of plants have efficiencies between those of ordinary primary and secondary treatment. Bacterial removal can be increased most effectively and economically by chlorination of the effluent from one of the above types of treatment plants. The cost of such disinfection is relatively small as compared with other treatment costs.

It is not necessary, nor would it be economically justified, to provide complete treatment for all sewage. The capacity of streams to purify themselves is a valuable and usable asset. The necessary degree of treatment depends on the self-purification capacity of the stream or streams involved and the necessary standard of water quality to avoid undue interference with normal water uses. The effects of industrial and mining wastes often play an important part in determining the necessary degree of treatment. In some instances the problem is one of primarily local interest and importance. In other instances large streams, large areas, or large numbers of people are involved and the problem assumes regional importance.


OHIO BASIN — WATER SUPPLIES
N
N.Y.
PENNA.
M.D.
OHIO
ILLINOIS
INDIANA
W. VIRGINIA
KENTUCKY
VIRGINIA
TENNESSEE
N. CAR.
S. CAR.
MISS.
GEORGIA
ALA.
LEGEND
SURFACE WATER
Stream – Impounded
UNDERGROUND WATER
QUANTITY
Gallons per day
Less than 200,000
200,000 — 1,000,000
1,000,000 — 10,000,000
10,000,000 — 20,000,000
over — 20,000,000
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1942
10 0 10 20 30 40
SCALE OF MILES

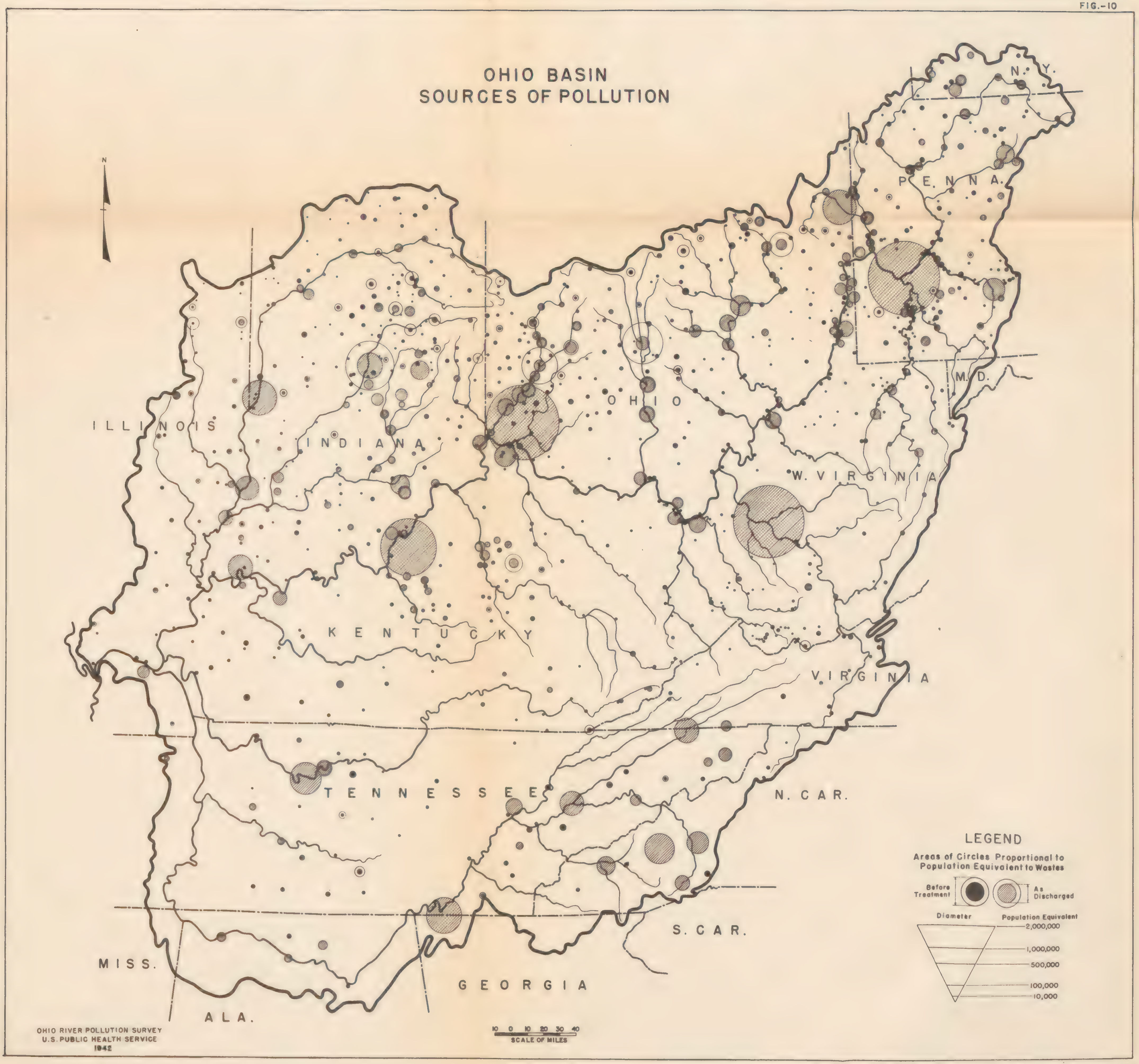

OHIO BASIN
SOURCES OF POLLUTION
N
N.Y.
PENNA.
MD.
OHIO
ILLINOIS
INDIANA
W. VIRGINIA
KENTUCKY
VIRGINIA
TENNESSEE
N. CAR.
S. CAR.
MISS.
ALA.
GEORGIA
LEGEND
Areas of Circles Proportional to Population Equivalent to Wastes
Before Treatment
As Discharged
Diameter
Population Equivalent
2,000,000
1,000,000
500,000
100,000
10,000
10 0 10 20 30 40
SCALE OF MILES
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1942

Figure 11 shows the progress that has been made in sewage treatment in the Ohio Basin since 1900. Prior to that time only two cities in the basin, Canton and Alliance, Ohio, had sewage-treatment plants other than a septic tank. The years from 1900 to 1920 saw the invention or introduction of the principal treatment devices in common use today. The years since 1920 have witnessed vast improvements in details and an increasing trend toward mechanization of plants. Steady progress at an almost constant rate was made in the construction of sewage-treatment works during the years prior to 1925. During the boom years in the latter part of the 1920's the rate accelerated but during the depression years from 1930 to 1934 such construction was practically at a standstill. The effect of various Federal-aid programs is shown by the greatly accelerated progress during the years from 1935 to 1940. As much progress has been made during these 6 years as had been made prior to 1935.

The cost of a suggested basin-wide program of sewage treatment is shown in table 1. The following data show the approximate number of plants that would be in operation upon completion of such a program, their capacity, and cost:

	Primary	Secondary	Total
Number of plants	650	700	1,350
Capacity (million gallons per day)	850	535	1,385
Cost [1]	$61,000,000	$58,000,000	$119,000,000

[1] These costs do not include interceptors.

These data indicate that the program is now about one-third complete. A continuation of the rate of progress made during the period 1935 to 1940 for 20 more years would be required to complete the suggested program. There are no technical or engineering reasons which would prevent completion of the presented program in 10 years or even less. In the few cases where research leading to the development of more efficient economical industrial waste-corrective measures has been indicated, 10 years should see substantial progress. There are legal and administrative barriers which tend to delay the program. The principal problem, however, is the financing of the program.

Upon completion of the suggested program the need for construction would be reduced but not entirely eliminated. Since the average life of treatment plants in the past has been about 20 years, many of the plants already built would need to be replaced and others would need major repairs or alterations. Eventually such work would probably cost about $6,000,000 per year.

INDUSTRIAL WASTES

Table 3 shows the number of plants of each of the principal types of industries discharging industrial wastes to the streams of the Ohio Basin and the estimated sewered population equivalent based on biochemical oxygen demand of the wastes from each type of industry. Although no single measure of pollution is applicable to all types of industrial wastes the biochemical oxygen demand is the most nearly satisfactory. Some industrial wastes contain chemicals which are toxic to aquatic life, some increase the acidity, hardness, or

Fig.—11

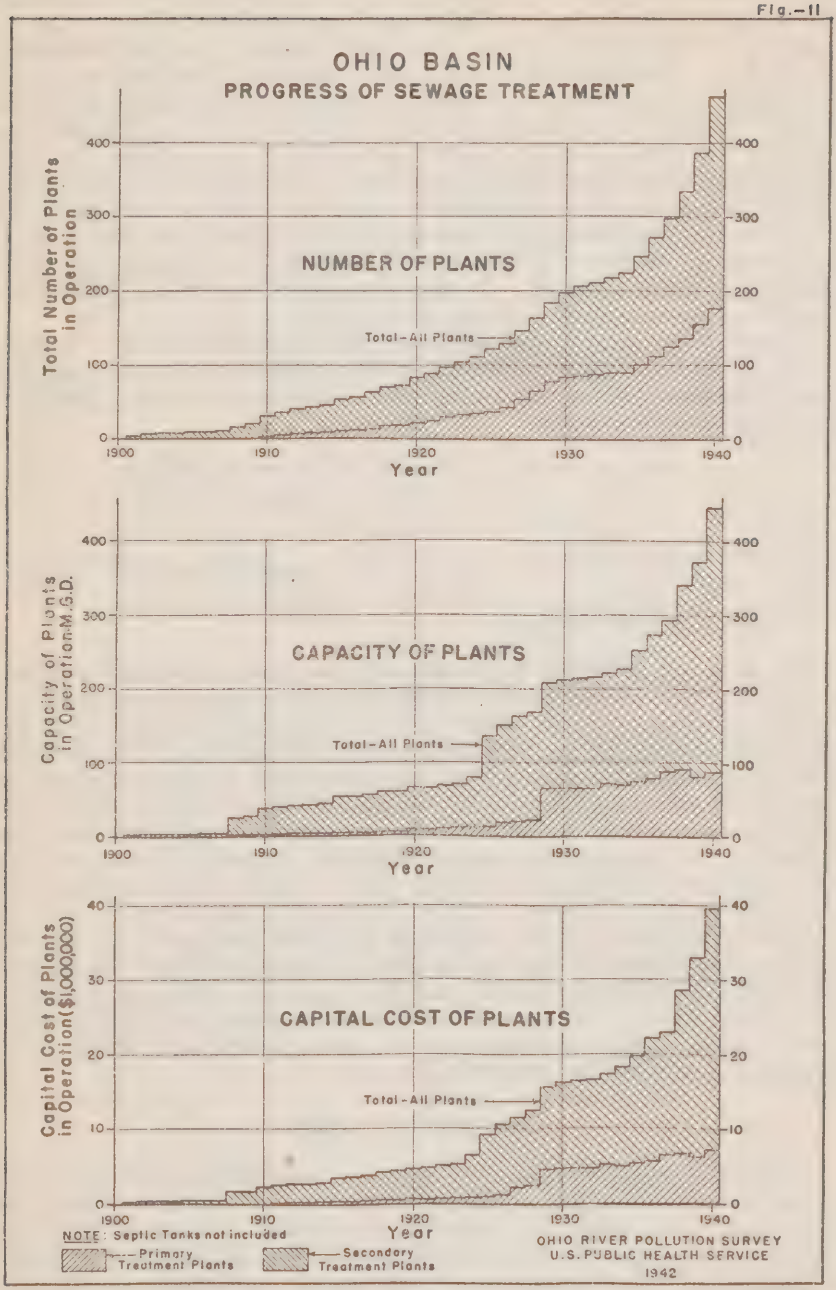

OHIO BASIN
PROGRESS OF SEWAGE TREATMENT
NUMBER OF PLANTS
Total Number of Plants in Operation
Total-All Plants
Year
CAPACITY OF PLANTS
Capacity of Plants in Operation-M.G.D.
Total-All Plants
Year
CAPITAL COST OF PLANTS
Capital Cost of Plants in Operation($1,000,000)
Total-All Plants
Year
NOTE: Septic Tanks not included
Primary Treatment Plants
Secondary Treatment Plants
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1942

Fig.-12
OHIO RIVER BASIN
SUGGESTED INDUSTRIAL WASTE CORRECTION

25 0 25 50 75 100 125 150 175 200
SCALE OF MILES

NOTE:- Exclusive of plants where present corrective measures are adequate

OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1942

GPO-43 O-90035

salinity of the streams, some cause tastes and odors in water supplies, some contain undesirable coloring matter. These characteristics require separate consideration in determining how and to what degree treatment of the wastes is needed.

TABLE 3.—*Ohio River Basin: Summary showing industrial wastes not discharging to municipal treatment plants, suggested industrial waste discharges to municipal treatment plants, and total of entire industrial waste load in the basin*

Industry [1]	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)	Suggested to municipal treatment	
		Municipal sewers	Private outlets			Number of plants	Population equivalent (biochemical oxygen demand)
Brewing	38	35	3	27	264,300	37	263,800
Byproduct coke	23	2	21	17	745,200	2	24,300
Canning	218	52	166	160	758,900	64	310,300
Chemical	65	10	55	36	1,880,400	8	138,000
Distilling	67	14	53	53	1,009,700	20	624,600
Meat	173	76	97	115	385,700	123	323,900
Milk	253	130	123	107	85,100	167	74,700
Oil refining	47	4	43	44	116,500	2	15,100
Paper	59	12	47	46	1,659,200	5	31,500
Steel	174	15	159	71	(2)	12	0
Tanning	32	5	27	13	269,600	13	55,400
Textile	122	57	65	10	335,100	84	216,900
Miscellaneous	333	104	229	109	160,300	89	132,500
Total	1,604	516	1,088	808	7,670,000	626	2,211,000
Industrial wastes to Cincinnati sewers [3]					1,108,400		1,108,400
Wastes discharged to municipal treatment					1,195,900		
Total for the basin					9,974,300		3,319,400

[1] Industries occurring only once in a basin are included under "Miscellaneous" in the basin summary but are under their proper classification in this table.
[2] 336,000 pounds free acid discharged daily in waste pickle liquor.
[3] Industries not surveyed individually. Population equivalent based on comprehensive sewer gaging and sampling program of city.

Reduction of industrial waste pollution is generally accomplished by one or more of the following methods:

(1) Changes within the plant itself. This may involve reuse of all or part of the waste within the plant, development of byproducts, changes in plant processes, or merely greater care in plant operation to reduce the amount of material discharged as waste.

(2) Treatment with municipal sewage. Many industrial wastes can be quite effectively treated in this way. It is often necessary to pretreat the wastes at the source or to segregate certain portions of the wastes within the plant and exclude these from the municipal sewers to prevent damage to sewerage structures or sewage treatment processes.

(3) Treatment in a special industrial waste treatment plant. For many types of wastes, such plants employ essentially the same processes as sewage-treatment plants. Other types of wastes require specially developed processes. Most of the plants use the principle of sedimentation for removal of settleable solids.

The first method is usually the most economical and is the one generally applied. It is occasionally possible to completely eliminate pollution and to recover valuable byproducts by changes within the plant but this is not the usual situation. Ordinarily some pollution

remains and some expense is involved. The second method is the simplest from the standpoint of the industry. It is also the most satisfactory from the standpoint of administration of pollution-abatement programs since it reduces the number of possible sources of pollution and concentrates responsibility for effective waste treatment. It is usually necessary to make special provisions in the design of a municipal sewage-treatment plant if an appreciable amount of industrial waste is to be treated. Subsequent changes in the industrial waste load sometimes cause difficulties. The third method is used when the first is insufficient and the second impracticable. In those cases where removal of settleable solids is sufficient the problem is not difficult but satisfactory methods for the relatively complete removal of biochemical oxygen demand are available for only a few of the more common types of wastes such as those from breweries, meat plants, milk plants, and some types of canneries and distilleries. There is a pressing need for the development of more efficient and economical methods for relatively complete treatment of other types of wastes. More complete discussions of industrial wastes and their treatment are found in the Industrial Waste Guides included as a supplement to this report.

Figure 12 shows the location of industrial plants of various types which will probably require individual remedial works and the location of industrial plants of all types which can probably be connected to existing or proposed municipal-treatment works.

ACID MINE DRAINAGE

The problem of acid mine drainage is one of the most pressing in the Ohio River Basin. Data relative to the discharge of the present acid load of 1,800,000 tons of mine acid per year are presented and discussed in a separate section of this report and in a more detailed supplement.

Water Quality

As a background for the presentation and discussion of extensive laboratory data, particularly in the individual summaries, a discussion of water quality requirements for various uses has been prepared. This is followed by a discussion of present water quality which summarizes briefly the quality of stream water in the basin as a whole. More detailed discussion and either individual or monthly average results are given in the basin summaries. A detailed outline of methods is presented in a supplement.

WATER QUALITY REQUIREMENTS

As a basis of comparing the sanitary conditions in streams of the Ohio River Basin from laboratory observations of their waters at various points, it is desirable to consider briefly the limiting characteristics of stream waters in general, when expressed in terms of laboratory data, which may serve to distinguish between suitable and unsuitable conditions for different water uses.

Of the more common water uses in the Ohio Basin, the most important one is public water supply, because a large proportion of the population resident in the basin is dependent on surface sources of

water for domestic and other essential uses. Secondary but also highly important is the growing use of natural waterways for recreation, together with the continuing need for support of fish and other higher aquatic life in streams. This latter need, though it bears a definite relation to recreational use of streams, is of much broader and more fundamental significance, as it has a direct bearing on the ability of all natural watercourses to maintain their normal capacity for self-purification.

Among other stream uses which are affected to some extent by sanitary conditions are those which have to do with industry, agriculture, navigation and general community development. In a broad sense, industrial needs for water are fairly similar to those of domestic supply, except that in some instances they have special requirements, either more or less rigid. In the Ohio Basin, agricultural use of surface water is mainly concerned with stock raising, as a large majority of farms have their own private wells for domestic supply, and irrigation is not a general problem. Navigation is affected by acid pollution and resulting corrosiveness and hardness of stream waters for boiler use. It also is adversely affected by gross sewage pollution which may cause "nuisance" and sludge banks. Community development is hampered, sometimes very materially, by poor sanitary conditions in streams which not only may cause serious damage to riparian property values, but also may interfere with the provision of desirable water-front highways, parkways, public landings and industrial docking facilities.

In order to systematize the discussion which follows, it will be convenient to consider the requirements for stream waters in terms of each separate characteristic as determined by the usual laboratory tests. In this connection, it is assumed that the methods of conducting the laboratory tests would conform very strictly to those of the latest Standard Methods of the American Public Health Association, and the American Water Works Association, as noted elsewhere in this report.

Coliform bacteria.—Bacteria of the coliform group are normal inhabitants of the intestinal tract of warm-blooded animals, including man, and are present in very high numbers in domestic sewage. As an index of sewage pollution, the number of coliform bacteria in a stream water is the most sensitive and reliable single determination available to the sanitarian. This number may be expressed in terms of the older "Phelps Index" or in terms of the more recent "most probable number". The latter method of enumeration has been followed throughout the present report.

Although the coliform bacteria number is used as an index of general sanitary conditions in natural bodies of water polluted by sewage, its more important applications are in judging as to the sanitary fitness of water supplies and their sources and of bathing waters. In flowing streams, progressive changes in the density of coliform bacteria below sources of pollution afford a valuable indication of the extent and rapidity of self-purification, after making due allowance for the effects of intermediate pollution and dilution. In interpreting the results of stream observations, the location of water-supply intakes and bathing places with reference to sources of pollution is an important matter for consideration in connection with coliform data.

Water Supply: Several years ago the Public Health Service conducted an exhaustive study [2] of the limiting densities of coliform bacteria in river and lake waters subjected to various degrees of purification, having particular reference to the production of finished waters meeting the bacteriological requirements of the Public Health Services' drinking water standards as promulgated in 1925.[3] The results of this study indicated that the average efficient water filtration plant, with postchlorination of the effluent included, can purify to the drinking water standards level a raw water having an average number of coliform bacteria up to 50 per milliliter (or 5,000 per 100 milliliters). Assuming that a drinking water of standard quality from this standpoint were judged on the basis of monthly average results of coliform determinations, this would imply that the raw water as delivered for treatment should not contain more than 50 per milliliter of coliform bacteria, as an average, during any month, if the limit of safe loading were not to be exceeded. This limit has been adopted by a number of States as a criterion in judging as to the fitness of sources of water supply subjected to ordinary filtration treatment for public use. Parallel studies indicate that the change from the Phelps Index to the most probable numbers has little effect on the conclusions of the original studies.

From the same study as above noted, two other coliform bacteria limits were determined which are of interest in this discussion. One was the upper limit of average coliform density, amounting to about 0.5 per milliliter (or 50 per 100 milliliters) which would permit the production of an effluent of standard quality by simple chlorination alone.

The second was the observation that when the ordinary filtration plant is reinforced by continuous prechlorination of the raw water in addition to postchlorination, the permissible maximum limit of coliform density in the raw water may be increased to about 200 per milliliter (or 20,000 per 100 milliliters). In this latter case, however, it was observed that raw waters showing monthly average coliform densities ranging from 50 to 200 per milliliter are in general unsatisfactory as sources of purified water supplies as they are likely to exceed coliform densities of 200 with a frequency ranging from over 5 to 20 percent of the time and thus overburden even a reinforced filtration plant for a correspondingly high proportion of the time. With raw waters polluted to this extent, moreover, difficulties of delivering palatable as well as safe effluents are increased, because of the presence of taste-producing substances originating both in sewage and in certain industrial wastes. These waters must be considered, therefore, as being of doubtful fitness as sources of water supply.

From these considerations the following general rules may be stated as to the fitness of stream waters as sources of public water supply, when related to their average coliform bacteria number during any month:

---

[2] Public Health Bulletins Nos. 172 and 193; Public Health Reports, Reprints Nos. 1114, 1170, 1392, 1434, and 1565. U. S. Public Health Service, Washington, D. C.

[3] Public Health Reports, April 10, 1925, pp. 699-721, (Reprint No. 1029).

Limiting average monthly coliform number per milliliter	Relative fitness
0 to 0.5	For purification by simple chlorination.
0.5 to 50	For purification by filtration and postchlorination.
50 to 200	Doubtful—unfit for ordinary filtration treatment (unsuitable if greater than 200 in more than 5 percent of samples).
Over 200	Unfit for treatment.

Bathing waters: Existing standards of quality for natural bathing waters, as distinguished from artificial pools, are highly variable among the different States and appear to be governed more by expediency than by any well-established observational data. The most reliable data bearing on the relation between observed quality of bathing waters and sanitary conditions affecting such waters as determined by physical surveys have come from Connecticut, where two studies of this kind have been made. Winslow and Moxon,[4] as the result of their study of bathing beaches near New Haven, recommended a standard providing an average coliform number not over 1 per milliliter and a maximum number not over 10. Scott,[5] on the basis of a survey of beaches along the Connecticut shore of Long Island Sound, set up four classes of bathing waters, based on coliform numbers. The best class, A, showed average numbers from 0 to 0.5 per milliliter. This class Scott considered as definitely good; classes B and C, rated as doubtful, showed ranges of 0.51–5 and 5–10, respectively. Class D, judged as very poor, gave average numbers over 10. The Tri-State Pollution Commission has adopted Scott's class A as the basis of requirements for natural bathing waters in the New York area.

From the evidence above cited, it would appear that the highest standard thus far proposed as the result of actual laboratory and sanitary surveys would conform to Scott's class A, though the Winslow-Moxon criterion, which also is based on good observational data, is nearly as high in its average requirements. For inland streams, the Winslow-Moxon standard might appear more reasonable, as it permits a degree of variability which is inherent in all stream waters. Bearing in mind that the most probable number method of coliform enumeration tends to give somewhat higher results than does the Phelps index method, the Winslow-Moxon criterion, based on most probable numbers, would be sufficiently rigid to be comparable to Scott's class A requirement when expressed in terms of the Phelps index. This requirement would appear to be a reasonably safe one for bathing waters in the Ohio River Basin.

Dissolved oxygen.—In unpolluted streams, the dissolved oxygen content tends to remain at or very near the saturation level. In polluted streams, it is depressed temporarily below points at which wastes are discharged into the stream, but tends to move gradually upward toward the saturation level along the familiar oxygen sag curve. The depth of the oxygen depression below saturation at the prevailing stream temperature is an index of the intensity of pollution in that particular stream zone. In streams only slightly or moderately

[4] Bacterial Pollution of Bathing Beach Waters in New Haven Harbor. C-E. A. Winslow and D. Moxon. American Journal of Hygiene, 8, 3, 299–310, May 1928.

[5] American Public Health Association. Reports of Joint Committee on Bathing Places.

polluted, the dissolved oxygen content usually remains above a level of 70 to 80 percent saturation. In grossly polluted streams it may reach zero saturation or total depletion, and remain thus throughout stretches of considerable length, particularly in summer low flows where underlying sludge deposits exist. Between these two extremely divergent oxygen levels are numerous intermediate ones, indicating various gradations of pollution between moderate and gross.

The minimum oxygen requirements for streams are, in general, dependent on the particular uses to which they are devoted, though 2 or 3 parts per million of oxygen in a stream usually marks the extreme minimum level. Septic conditions and general "nuisance" follow inevitably the continuance of oxygen levels at or near the zero point.

For maintenance of native fish life Ellis [6] states, from studies by the Bureau of Fisheries, that an oxygen minimum of 5 parts per million is necessary. Although many fish of the more hardy varieties will survive at oxygen levels of 4 or even 3 parts per million, he shows that the metabolic processes of most common fish are hampered at levels below 5 parts per million and points out that the mere survival or tolerance level is too low to permit the breeding and self-maintenance of the desirable forms of native fish.

Ellis' conclusions have been confirmed fully by the biological observations made in connection with the present Ohio River Pollution Survey. [7] These observations, as described in a supplement of the present report, have indicated that in regions of heavy pollution, with dissolved oxygen below 3 parts per million, fish are mostly absent, with occasional carp, buffalo, and sunfish. In zones of intermediate pollution, with dissolved oxygen, 3 to 5 parts per million, fish are more abundant, but "showing a tendency to sickness, deformity, and parasitization." In fertile zones, with dissolved oxygen not below 5 parts per million, it has been observed that "fish are varied, plentiful, and healthy," with large numbers of market fish present. In game fish zones, where oxygen is always above 5 parts per million, and usually near saturation, the presence of bass, perches, pike, and forage fish has been noted.

The striking agreement thus shown between the findings of the present survey and those of Ellis from his previous survey would seem to leave no room for doubt as to the validity of the conclusion reached by both observers concerning the desirability of a 5 parts per million oxygen minimum in stream zones where the proper maintenance of native fish life is an important consideration.

On the basis of stream uses and conditions, the following summary may be given of the oxygen status of streams, from present evidence:

Minimum daily average dissolved oxygen, parts per million	Stream conditions
0 to 3	Heavy pollution, probable nuisance at times, little fish life.
3 to 5	Moderate to heavy pollution, no nuisance, fish life restricted to coarse species.
Over 5	Slight to moderate pollution, fish life varied, abundant, and healthy, game fish at higher minimum levels.

[6] Detection and Measurement of Stream Pollution. M. M. Ellis, Bull. 22, U. S. Bureau of Fisheries, 1937.
[7] Ohio River Pollution Survey; Report of Biological Studies. Supplement F to this report.

In general, the minimum oxygen ranges above given might be considered as minimum daily averages. When expressed in terms of averages for periods of several days up to a month, it would be desirable to add about 1.5 to 2 parts per million to each daily minimum figure in order to safeguard against daily variations below the period average. Figure 12a, page 174, shows the relationship between monthly average and minimum daily dissolved oxygen results based on the results of 7,500 samples collected during the present and previous surveys of the Ohio River and its tributaries. In order to assure the maintenance of a 5 parts per million daily minimum, a period average up to a month would be set at a minimum of 6.5 or 7 parts per million.

A possible question might be raised as to whether it may be necessary or even desirable to maintain a 5 parts per million oxygen minimum in all parts of a stream, including limited zones immediately below sources of pollution. It may be argued with some reason that it is not essential to the general support of fish life in streams to maintain such life unimpaired at all points, so long as the minimum dissolved oxygen does not fall below limits of tolerance for fishes, permitting them to pass through certain zones in order to reach their normal breeding places. Where sources of pollution are isolated and well separated by zones of active stream recovery, it is quite possible that an oxygen minimum of 4 parts per million in limited zones immediately below each source of pollution would be permissible. Where these sources are not isolated but are located so closely together that recovery is not possible within a reasonable distance, a definite hazard to fish life then may exist, even if a 4 parts per million minimum is maintained, in preventing the free movement of fish from one recovery zone to another. In general, it may be said that a 5 parts per million minimum is desirable, except where local conditions may be favorable to allowing a 4 parts per million minimum in limited zones immediately below fairly isolated sources of pollution.

Biochemical oxygen demand.—In connection with the present survey, a marked degree of correlation has been shown between the observed 5-day biochemical oxygen demand of stream waters at points immediately below sources of pollution and known densities of pollution at these points. A similar correlation has been shown between the 5-day biochemical oxygen demand and the numbers of coliform bacteria as observed at the same sampling points. In view of these relationships, an effort has been made to ascertain, from a study of the laboratory data, the approximate ranges of biochemical oxygen demand which may serve to distinguish between stream waters of various degrees of pollution, such as heavy, moderate, and slight. A source of difficulty in this connection lies in the considerable variability with which natural purification appears to affect the observed biochemical oxygen demand in streams of different sizes. In small and shallow streams, observed biochemical oxygen demand tends to diminish very rapidly under low-flow conditions, partly because of sedimentation, but also probably because of conditions favorable to rapid oxidation by growths of bacterial flora resembling activated sludge, attached to the sides and bottom of the channel. In larger streams, this effect is generally less marked, possibly because of the lesser effect of these bacterial growths.

In general, it has been observed that stream waters in the Ohio River Basin only slightly or very moderately polluted tend to show

Fig.-12a.

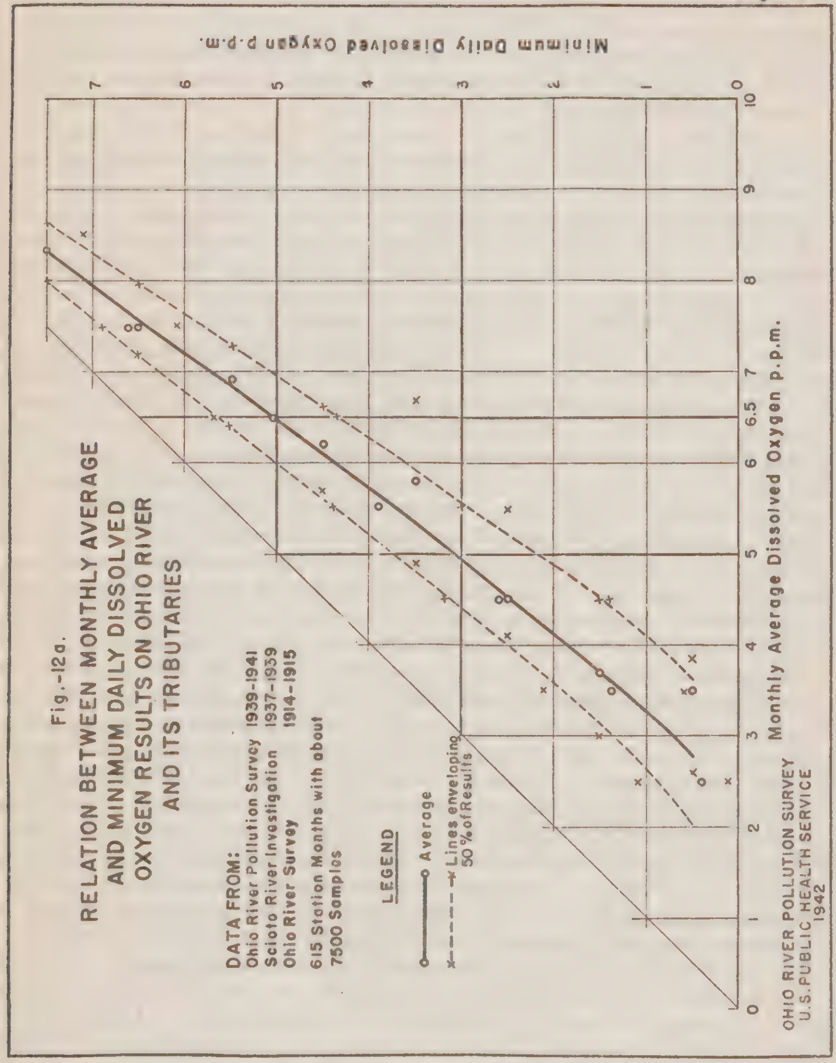


Fig.-12a.
RELATION BETWEEN MONTHLY AVERAGE AND MINIMUM DAILY DISSOLVED OXYGEN RESULTS ON OHIO RIVER AND ITS TRIBUTARIES
DATA FROM:
Ohio River Pollution Survey 1939-1941
Scioto River Investigation 1937-1939
Ohio River Survey 1914-1915
615 Station Months with about 7500 Samples
LEGEND
Average
Lines enveloping 50% of Results
Minimum Daily Dissolved Oxygen p.p.m.
Monthly Average Dissolved Oxygen p.p.m.
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1942

day biochemical oxygen demand values averaging less than 3 parts per million, with relatively low numbers of coliform bacteria and dissolved oxygen contents ranging above 5 or 6 parts per million. In moderately polluted streams the biochemical oxygen demand may range from 3 to 5 parts per million, with correspondingly higher coliform numbers and somewhat lower dissolved oxygen levels, though in the latter case exceptions may occur when the observations are made at points very close to sources of pollution, where the full effect of the oxygen sag curve has not yet become manifest.

The gradations in biochemical oxygen demand may, therefore, be summarized about as follows:

Maximum monthly average 5-day biochemical oxygen demand, parts per million	Stream conditions
... 3	Slight to moderate pollution.
... to 5	Moderate to moderately heavy pollution.
Over 5	Heavy pollution.

A complicating element in interpreting the results of biochemical oxygen demand tests is found in acid streams receiving mine wastes. Under these conditions little, if any, direct correlation exists between the observed biochemical oxygen demand and the density of pollution.

Sludge deposits.—Organic sludge deposits may be formed in streams as the result of discharging raw sewage and certain types of industrial wastes. Where present, they tend to impose an added burden on the oxygen resources of a stream and also to exert a very damaging effect on fish life. When present in large amounts, sludge deposits may bring about septic conditions, with a consequent breaking down of the self-purification capacity of the stream and depletion of the dissolved oxygen supply in the overlying water. Loss of fish life is due to suffocation from oxygen depletion, to toxic effects of heavy pollution, and to interference by sludge deposits with the spawning process, on which depends the normal reproduction of fish. An additional effect of extensive sludge deposits is the presence of floating solids and often obnoxious odors resulting from anaerobic decomposition of the deposits.

From these considerations, it is evident that the maintenance of desirable stream conditions necessitates the practical absence of organic sludge deposits originating in sewage and certain types of industrial wastes. Where these deposits are localized, small in extent, and subject to frequent removal by the flushing action of increased stream flows, their effects on a stream may not be very far-reaching. Nevertheless, they are always a detriment and should be eliminated so far as possible from streams in which it is desired to maintain healthy conditions.

Alkalinity, acidity, and hydrogen ion concentration.—The normal alkalinity of streams in the Ohio River Basin varies widely, even where uncomplicated by acidity from mining and steel-mill wastes. In the Ohio River proper and its major tributaries at their mouths, the alkalinity tends to range from about 30 to 200 parts per million, depending on the geological character of the watershed, and particularly the extent of limestone formations. In a very few streams near the headwaters of some tributaries, normal alkalinities as low as 20 parts per million, or even lower, have been recorded. Ordinarily,

the alkalinity tends to range above 30 or 40 parts per million over large portion of the basin.

Acidity in Ohio River streams is due to the effect of mine wastes and, in some local areas, of steel-mill wastes, though the former constitute by far the larger sources of acid pollution. The pH value range accordingly from as low as 2.0 or 3.0 in highly acid streams t as high as 8.0 or more in highly alkaline streams.

In general, it is desirable to have not less than 15 or 20 parts p million of natural alkalinity in stream waters used as sources of water supply, owing to the absorption of alkalinity by coagulants most commonly used in water purification. Acid waters can be treated by adding alkalinity in the forms of lime or soda ash, but the expens of treatment is increased accordingly, and their permanent or scale-forming hardness is also increased. Where acidity is highly variable difficulties occur in water treatment because rapid changes in th acidity, if not promptly corrected, may result immediately in in proper coagulation, or even in nullifying it completely.

According to Ellis' findings, the water of flowing streams tends to range from pH 6.7 to pH 8.6, where unpolluted by municipal industrial wastes. When more acid than pH 6.7, or more alkaline than pH 8.6, as the result of pollution, he states that the buffer and carbonate systems are usually so disturbed that conditions harmfu to fish are generally found. This natural range is, therefore, th most desirable one for maintenance of healthy fish life in streams Ellis states further that pH 4.0 or less is definitely lethal to all fish He points out, however, that in determining the lethality of ac wastes, the specific acid involved must be considered, as "acid waste do not kill merely because of a particular degree of acidity." Re viewing all of the data on acid wastes, he states that the truly ac effects must be limited to those acids which kill at pH values less tha 5.0, whereas in the case of acids killing at pH values more than 5. lethality factors other than hydrogen ion concentration play t major part.

From these considerations, it would appear that pH 5.0 marks th lowest safe minimum value for maintenance of normal fish life streams, when expressed without reference to the particular kind acidity involved. As an upper limit of alkalinity, that which co responds to pH 9.5 may be regarded as the maximum tolerable valu The following summary of variation limits, expressed in terms of t pH value, may be useful in this connection:

Average daily pH values	Stream conditions
6.5 to 8.6	Normal for unpolluted streams, favorable to fish life, suitable for water supplies.
5.5 to 6.5	Moderate acid pollution, tolerable to fish life, suitable for water supplies prio treatment.
4.0 to 5.5	Moderately heavy acid pollution, detrimental to fish life, fairly suitable for wa supplies prior to treatment.
Less than 4.0	Heavy acid pollution, lethal to fish life, unfavorable for water supplies pri treatment.

Table 4, page 177, presents a condensed summary of the limit characteristics of stream waters considered, respectively, as "d sirable," "doubtful" and "unsuitable" from the standpoint of co bined water uses. For water supplies, the requirements in respe to coliform bacteria, pH, and phenols are of more importance. F fish-life maintenance, dissolved oxygen, biochemical oxygen deman pH values, and sludge deposits are especially significant.

TABLE 4.—*Ohio Basin: Water quality requirements—Summary of limiting quality requirements for strea.. waters with principal stream uses and conditions involved in each category*

[These values should not be arbitrarily applied to streams other than those of the Ohio River Basin as each stream should be reviewed in the light of its own peculiar biological characteristics]

		Desirable	Doubtful	Unsuitable
		WATER SUPPLY—GENERAL SANITARY CONDITIONS		
Coliform bacteria per milliliter	Average	Not over 50 in any month. (filtration treatment required if over 0.5).	50-200 in any month (unsuitable if greater than 200 in more than 5 percent of samples).	Over 200 in any month.
		BATHING—RECREATION		
Coliform bacteria per milliliter	Average Maximum	Not over 1.0 Not over 10.0.	1.0-10.0	Over 10.0.
		FISH LIFE—RECREATION—GENERAL SANITARY CONDITIONS		
Dissolved oxygen parts per million.	Average Minimum	Not less than 6.5 in any month Not less than 5.0 on any day	5.0 [1]-6.5 in any month 3.0-5.0 on any day	Less than 5.0 in any month.[1] Less than 3.0 on any day.
		GENERAL SANITARY CONDITIONS—RECREATION		
5-day biochemical oxygen demand parts per million.	Average	Not over 3.0 in any month	3.0-5.0 in any month	Over 5.0 in any month.
		WATER SUPPLY—FISH LIFE—RECREATION—NAVIGATION—INDUSTRY		
pH		6.5-8.6	4.0-6.5 or 8.6 to 9.5 [2] Suitable for water supply prior to treatment.	Less than 4.0 or over 9.5.[2] Unfavorable for water supply prior to treatment.
		FISH LIFE—RECREATION—GENERAL SANITARY CONDITIONS		
Sludge deposits		No preventable deposits present	Slight to moderate—localized	Moderate to heavy—general.
		WATER SUPPLY		
Phenols, parts per billion		Not over 1	1-10	Over 10.
		WATER SUPPLY—RECREATION—FISH LIFE		
Other conditions		No toxic substances, oils, tars, or free acid at any time; no floating solids or debris, except from natural sources; no taste-producing substances.	Free acidity at any time, chlorides over 250 parts per million; occasional taste-producing substances.	Toxic substances, oils, or tars present at any time; free acidity present frequently; taste-producing substances present frequently.

[1] In general, it may be said that a 5 parts per million minimum is desirable, except where local conditions may be favorable to allowing a 4 parts per million minimum in limited zones immediately below fairly isolated sources of pollution. See discussion, p. 173.

[2] U. S. Public Health Service drinking water standards permit pH 10.6 in "treated" water.

Discussion.—According to the evidence at hand the water characteristics designated as "desirable" and "unsuitable" in the summary table appear to fall quite definitely into these two opposite categories. The intermediate or "doubtful" group defines characteristics which may be tolerable but undesirable, or may approach unsuitability, according to their relative position in the ranges given. No hard and fast line may be drawn for this "doubtful" group, but some degree of flexibility in judgment must be exercised in individual cases.

The requirements set forth in these three categories have not been intended to constitute a formal classification of stream waters in the Ohio River Basin, so far as the present report is concerned. It is fairly evident, however, that the mere endeavor to define stream characteristics in terms of their relative suitability for various water uses involves, in effect, the principle of classification, whether or not this term be used in this connection. It also involves the idea of stream standards, which form an essential part of any system of stream classification.

The application of the tentative limiting requirements for stream water quality, as set forth in this chapter, to the estimation of corrective measures for pollution in any given stream zone, would involve four steps as follows:

(1) Determination of essential or desirable stream uses in the particular zone concerned.

(2) Fixing of necessary requirements for stream water quality in the zone, based on "essential" or "desirable" uses as defined under (1).

(3) Determination of existing stream conditions in the zone, based primarily on systematic laboratory observations above and below known sources of pollution and at other significant points.

(4) Estimation of necessary corrective measures for pollution loading at specific points, in order to meet essential or desirable stream-quality requirements, on the basis of existing stream conditions and known pollution loadings at such points.

In interpreting the results of laboratory observations, due account should be taken of flow and seasonal conditions prevailing during the periods of the observations, with special reference to those conditions which might be considered as critical for the particular water uses involved. If the results observed at any time were definitely bad or unfavorable, such a finding would be significant regardless of whether or not the flow conditions were at a "critical" level. If the results at such a time were favorable and stream conditions were not at the "critical" level, then the possibility of unfavorable findings under conditions approaching more closely the critical point would have to be considered. In this connection, it should be pointed out that "critical" stream conditions would vary to some extent according to the particular water use involved. Where recreational use, maintenance of fish life, or prevention of "nuisance" is concerned, critical stream conditions usually coincide with those of extremely low water in the mid or late summer. For water supplies, the more critical conditions often occur following major rises in streams during the winter or spring months, when the effects of sewage pollution and of scoured sludge deposits at downstream points are at a maximum.

PRESENT WATER QUALITY

As a means of indicating the effect of existing pollution in the basin on the sanitary quality of the water, the laboratory results have been grouped on the basis of concentration of coliform organisms, dissolved oxygen and biochemical oxygen demand as outlined in the section on water quality requirements.

Table 5 summarizes the results of coliform organism and biochemical oxygen demand tests. The table shows the number of stations in each basin at which the worst monthly average results were within various ranges.

TABLE 5.—*Ohio Basin: Number and percentage of sampling stations showing worst monthly average coliform and biochemical oxygen demand results within designated ranges*

Basin	Number of stations						Percentage of stations					
	Coliform organisms per milliliter			Biochemical oxygen demand in parts per million			Coliform organisms per milliliter			Biochemical oxygen demand in parts per million		
	0-50	51-200	Over 200	0-3	3.1-5.0	Over 5	0-50	51-200	Over 200	0-3	3.1-5.0	Over 5
Allegheny:												
Acid streams	73	4	2	59	16	4	92	5	3	75	20	5
Normal streams	91	30	38	121	15	23	57	19	24	76	9	15
Total	164	34	40	180	31	27	69	14	17	76	13	11
Monongahela:												
Acid streams	48	7	10	45	2	18	74	11	15	69	3	28
Normal streams	29	20	44	70	6	17	31	22	47	75	7	18
Total	77	27	54	115	8	35	49	17	34	73	5	22
Muskingum:												
Acid streams	2	2	1	5	0	0	40	40	20	100	0	0
Normal streams	33	33	42	86	9	13	31	31	38	80	8	12
Total	35	35	43	91	9	13	31	31	38	80	8	12
Hocking:												
Acid streams	5	1	3	4	3	2	56	11	33	45	33	22
Normal streams	6	3	9	6	3	9	33	17	50	33	17	50
Total	11	4	12	10	6	11	41	15	44	37	22	41
Kanawha:												
Acid streams	6	1	1	6	1	1	75	12	13	75	12	13
Normal streams	74	26	42	106	16	20	52	18	30	75	11	14
Total	80	27	43	112	17	21	53	18	28	75	11	14
Beaver	21	15	29	35	13	17	32	23	45	54	20	26
Little Kanawha	0	5	5	7	1	2	0	50	50	70	10	20
Guyandot	16	5	7	17	6	5	57	18	25	61	21	18
Big Sandy	33	18	37	64	10	14	38	20	42	73	11	16
Scioto	32	15	38	37	17	30	38	17	45	44	20	36
Little Miami	5	2	28	6	11	18	14	6	80	17	31	52
Licking	24	7	3	19	13	12	71	21	8	43	30	27
Miami	12	18	37	21	29	29	18	27	55	26	37	37
Kentucky	32	20	29	52	11	18	39	25	36	64	14	22
Salt	12	4	9	9	6	10	48	16	36	36	24	40
Green	31	1	14	36	0	10	67	2	31	78	0	22
Wabash	102	46	122	94	62	114	38	17	45	35	23	42
Cumberland	45	27	39	73	19	18	41	24	35	66	17	17
Tennessee	55	33	61	97	17	36	37	22	41	65	11	24
Tributary totals	787	343	650	1,075	286	440	44	19	37	60	16	24
Ohio River and minor tributaries:												
Pittsburgh-Huntington	23	43	36	72	7	23	23	42	35	70	7	23
Huntington-Cincinnati	6	8	14	21	4	3	22	28	50	75	14	11
Cincinnati-Louisville	4	9	20	10	14	9	12	27	61	30	43	27
Lousiville-Mouth	31	20	23	47	11	14	42	27	31	66	15	19
Ohio River total	64	80	93	150	36	49	27	34	39	64	15	21

In general, the largest number and highest percentage of stations falling within the lowest range of coliform densities (0 to 50 per milliliter) and biochemical oxygen demand concentrations (0 to 3 parts per million) indicate the better sanitary quality of the waters of the basin subdivision. Conversely, the largest number of stations and highest percentages of the stations falling in the higher ranges of coliform density (over 200 per milliliter) and biochemical-oxygen-demand concentration (over 5 parts per million) indicate more highly polluted conditions of the waters of the basin and less desirable water for domestic supply and other customary uses.

The tabulations of coliform organisms show clearly the effects of acidity in the tendency for higher percentages of the stations in acid streams to show coliform numbers in the lower density range as contrasted with the corresponding percentages for the normal alkaline streams.

On figures 13 to 15 the average analytical results for the entire basin have been grouped to show graphically areas of comparable sanitary quality of the streams as indicated by the particular determination used as the index.

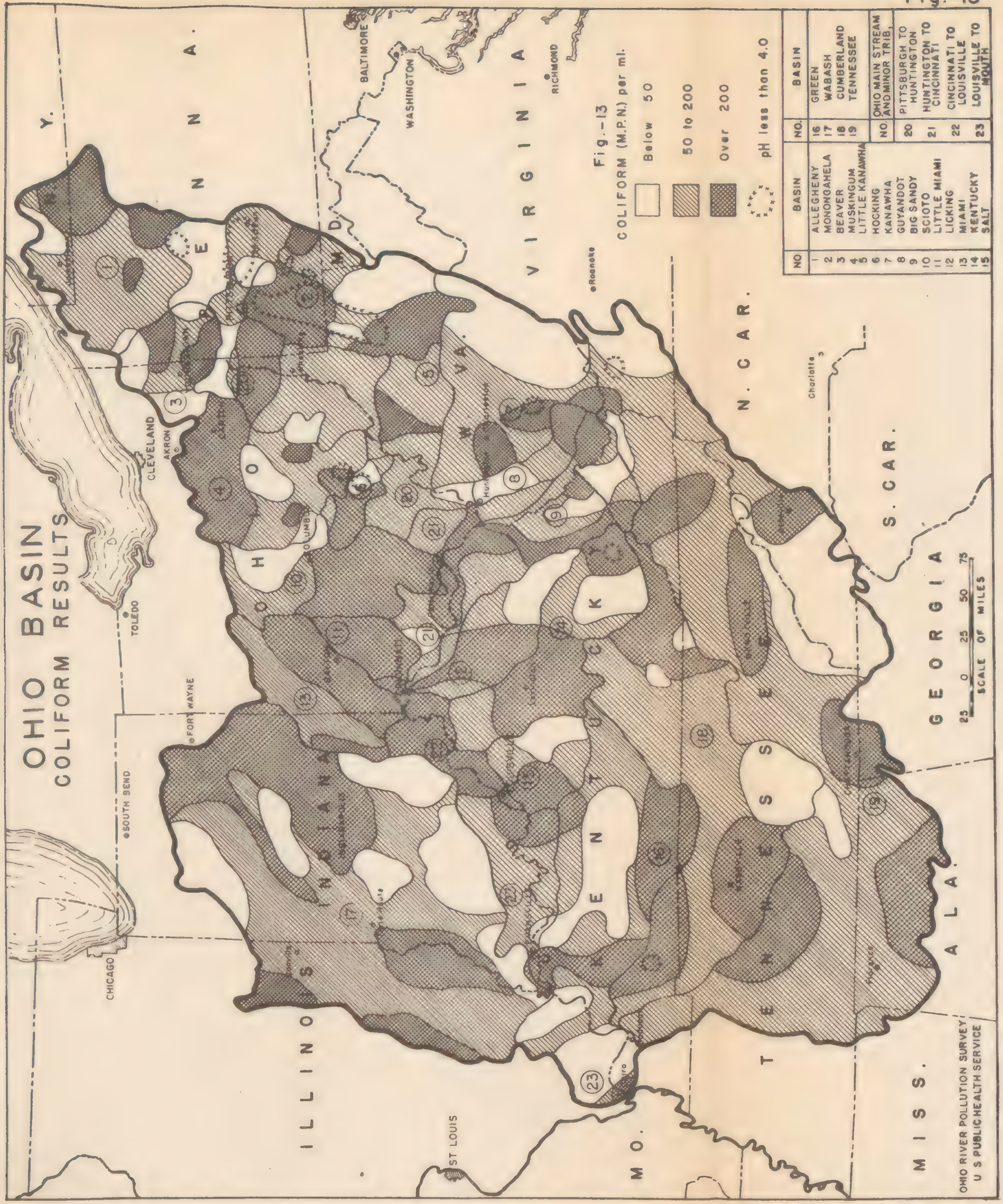
Coliform bacteria.—Figure 13, based on the determination of coliform bacteria, shows, by the heavier shading, areas in which the highest monthly average numbers of coliform bacteria exceeded 200 per milliliter. Lighter shaded portions show areas in which the highest monthly average number of coliform organisms was between 200 and 50 per milliliter and the unshaded areas show, in general, areas with coliforms less than 50 per milliliter.

In general, 50 coliform organisms per milliliter represent the desirable upper limit of bacterial concentration for sources of water supplies. In all areas except those included within portions of the Allegheny and Monongahela Basins, affected by acid mine drainage, the lightly shaded areas indicate stream zones in which good sanitary conditions were found, resulting largely from a relatively low degree of pollution. Except in the Muskingum, Green, and Wabash Basins, these areas are located mostly near the outer edges of each tributary basin in their headwater sections. They include several areas in which recreational use of streams either is being practiced or readily can be developed, notably in the southern portions of the basin. They also include areas offering either actual or potentially desirable sources of water supply.

Areas in which the highest average numbers of coliform organisms exceeded 200 per milliliter include the larger sources of pollution and numerous local zones of smaller streams affected by the discharge of untreated sewage. The effects of industrial wastes probably are not shown to any considerable extent on this diagram, as the coliform bacteria is definitely specific as an index of sewage pollution. It is noteworthy, however, that the general locations and extent of these areas reflect to some degree the effects of combined sewage and industrial pollution, as the larger sources of sewage tend to coincide with those of industrial wastes.

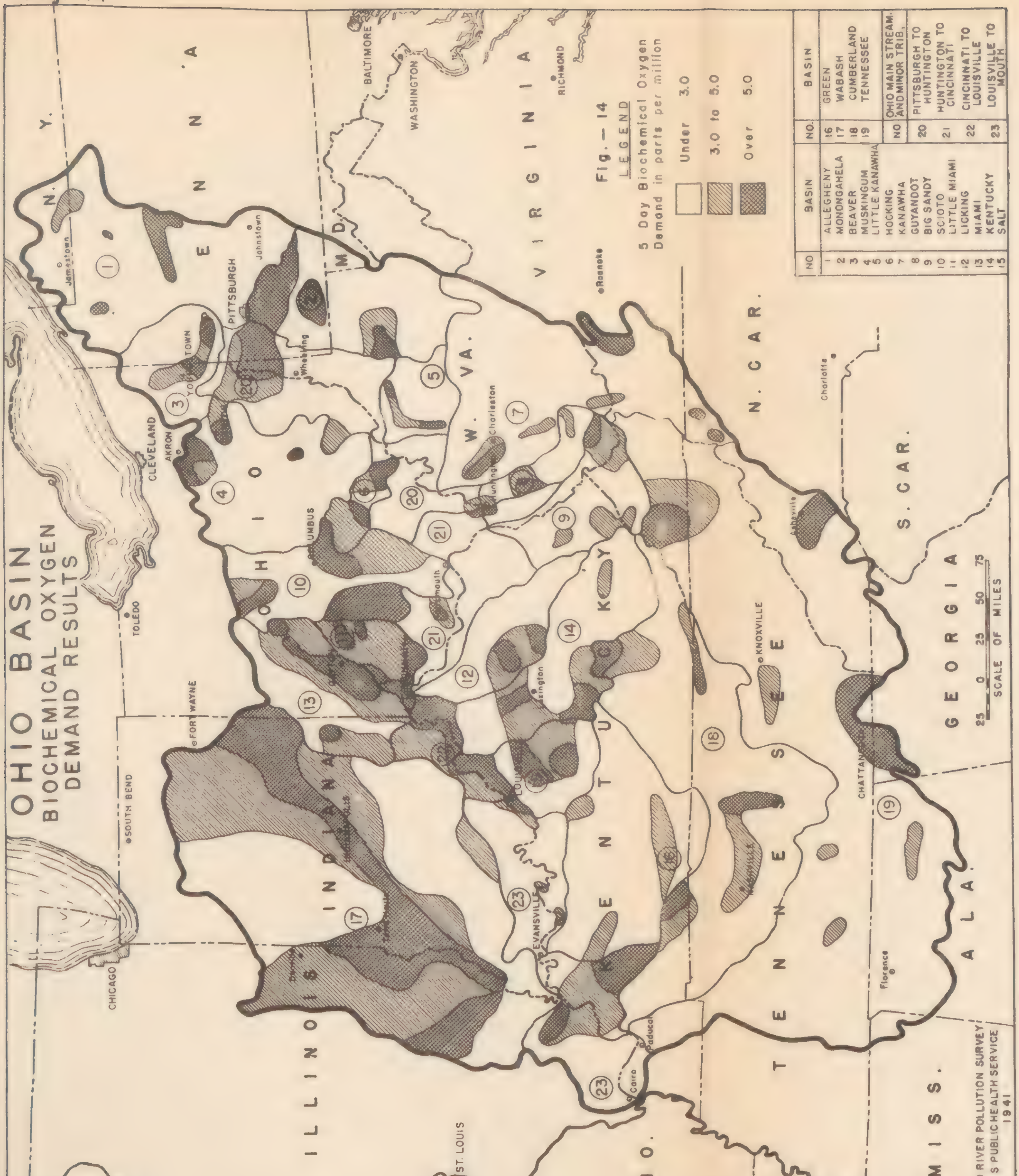
Biochemical oxygen demand.—On figure 14 the basin has been divided into areas on the basis of biochemical oxygen demand, the darkest shading representing average amounts of the biochemical oxygen demand exceeding 5 parts per million, the next heaviest areas those in which the average ranged from 3 to 5 parts per million, and the

Fig.-13

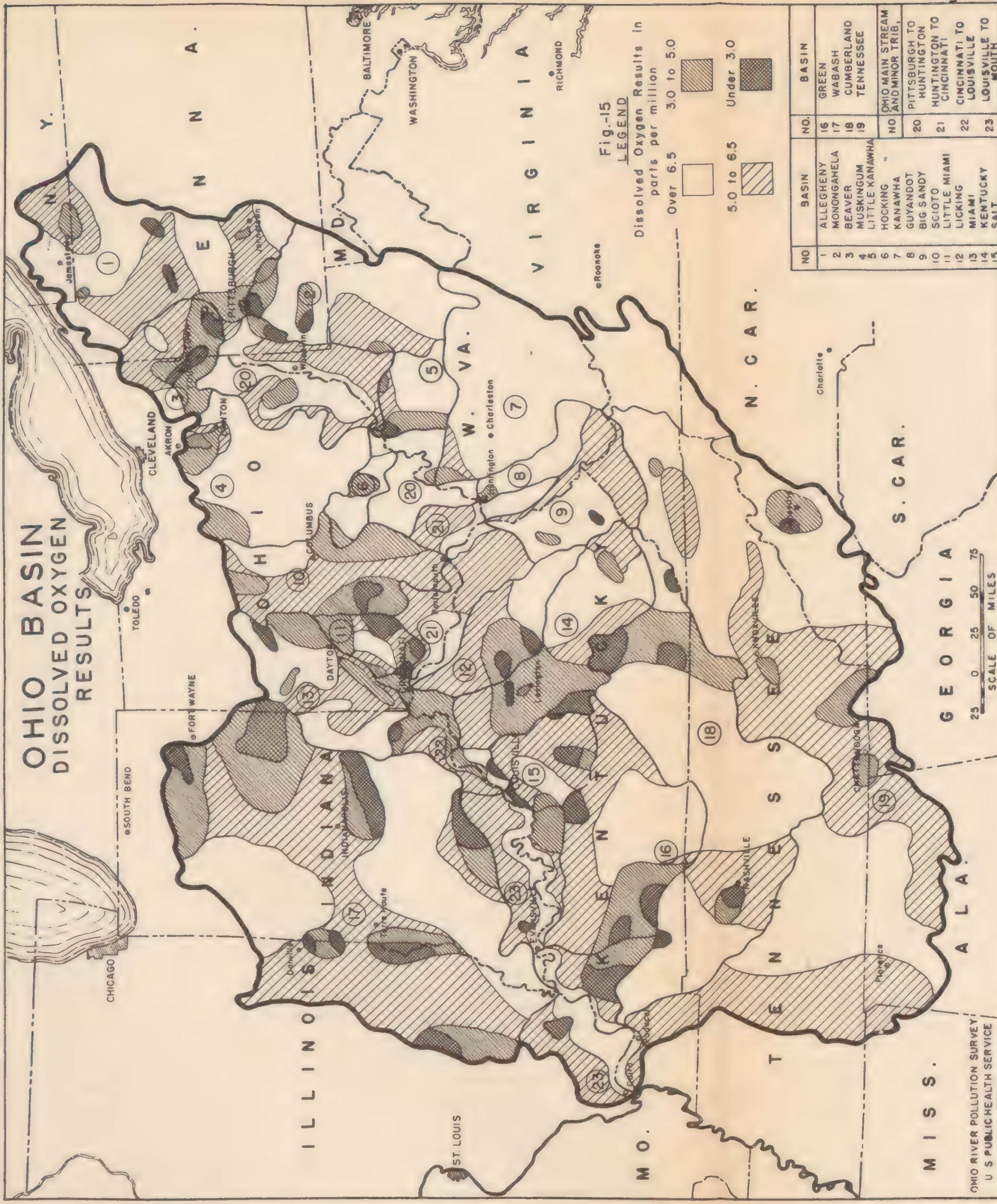


OHIO BASIN
COLIFORM RESULTS
Fig.-13
COLIFORM (M.P.N.) per ml.
Below 50
50 to 200
Over 200
pH less than 4.0
NO | BASIN
1 ALLEGHENY
2 MONONGAHELA
3 BEAVER
4 MUSKINGUM
5 LITTLE KANAWHA
6 HOCKING
7 KANAWHA
8 GUYANDOT
9 BIG SANDY
10 SCIOTO
11 LITTLE MIAMI
12 LICKING
13 MIAMI
14 KENTUCKY
15 SALT
16 GREEN
17 WABASH
18 CUMBERLAND
19 TENNESSEE
NO. | OHIO MAIN STREAM AND MINOR TRIB.
20 PITTSBURGH TO HUNTINGTON
21 HUNTINGTON TO CINCINNATI
22 CINCINNATI TO LOUISVILLE
23 LOUISVILLE TO MOUTH
SCALE OF MILES
25 0 25 50 75
OHIO RIVER POLLUTION SURVEY
U S PUBLIC HEALTH SERVICE
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
W. VA.
VIRGINIA
PENNA.
MD.
N. Y.
N. CAR.
S. CAR.
GEORGIA
ALA.
MISS.
MO.
CHICAGO
SOUTH BEND
FORT WAYNE
TOLEDO
CLEVELAND
AKRON
COLUMBUS
ST LOUIS
BALTIMORE
WASHINGTON
RICHMOND
Roanoke
Charlotte

Fig. -14



OHIO BASIN
BIOCHEMICAL OXYGEN
DEMAND RESULTS
Fig. — 14
LEGEND
5 Day Biochemical Oxygen Demand in parts per million
Under 3.0
3.0 to 5.0
Over 5.0
NO | BASIN
1 ALLEGHENY
2 MONONGAHELA
3 BEAVER
4 MUSKINGUM
5 LITTLE KANAWHA
6 HOCKING
7 KANAWHA
8 GUYANDOT
9 BIG SANDY
10 SCIOTO
11 LITTLE MIAMI
12 LICKING
13 MIAMI
14 KENTUCKY
15 SALT
16 GREEN
17 WABASH
18 CUMBERLAND
19 TENNESSEE
OHIO MAIN STREAM AND MINOR TRIB.
20 PITTSBURGH TO HUNTINGTON
21 HUNTINGTON TO CINCINNATI
22 CINCINNATI TO LOUISVILLE
23 LOUISVILLE TO MOUTH
25 0 25 50 75
SCALE OF MILES
OHIO RIVER POLLUTION SURVEY
U S PUBLIC HEALTH SERVICE
1941
N. Y.
P E N N A
O H I O
INDIANA
I L L I N O I S
K E N T U C K Y
T E N N E S S E E
W. VA.
V I R G I N I A
MD.
N. CAR.
S. CAR.
G E O R G I A
A L A.
M I S S.
MO.
Jamestown
Johnstown
PITTSBURGH
YOUNGSTOWN
Wheeling
CLEVELAND
AKRON
TOLEDO
FORT WAYNE
SOUTH BEND
CHICAGO
ST. LOUIS
Cairo
Paducah
EVANSVILLE
Charleston
Roanoke
RICHMOND
WASHINGTON
BALTIMORE
Charlotte
Asheville
KNOXVILLE
CHATTANOOGA
Florence


OHIO BASIN
DISSOLVED OXYGEN
RESULTS
Fig.-15
LEGEND
Dissolved Oxygen Results in
parts per million
Over 6.5
3.0 to 5.0
5.0 to 6.5
Under 3.0
NO
BASIN
1 ALLEGHENY
2 MONONGAHELA
3 BEAVER
4 MUSKINGUM
5 LITTLE KANAWHA
6 HOCKING
7 KANAWHA
8 GUYANDOT
9 BIG SANDY
10 SCIOTO
11 LITTLE MIAMI
12 LICKING
13 MIAMI
14 KENTUCKY
15 SALT
16 GREEN
17 WABASH
18 CUMBERLAND
19 TENNESSEE
OHIO MAIN STREAM AND MINOR TRIB.
20 PITTSBURGH TO HUNTINGTON
21 HUNTINGTON TO CINCINNATI
22 CINCINNATI TO LOUISVILLE
23 LOUISVILLE TO MOUTH
25 0 25 50 75
SCALE OF MILES
OHIO RIVER POLLUTION SURVEY
U S PUBLIC HEALTH SERVICE
1941
N. Y.
P E N N A.
M D.
V I R G I N I A
W. VA.
O H I O
I N D I A N A
I L L I N O I S
K E N T U C K Y
T E N N E S S E E
N. CAR.
S. CAR.
G E O R G I A
A L A.
M I S S.
M O.
CHICAGO
SOUTH BEND
FORT WAYNE
TOLEDO
CLEVELAND
AKRON
CANTON
PITTSBURGH
BALTIMORE
WASHINGTON
RICHMOND
Roanoke
Charleston
Huntington
COLUMBUS
DAYTON
Portsmouth
Louisville
Lexington
Nashville
Knoxville
Chattanooga
Florence
Paducah
Evansville
Terre Haute
Danville
INDIANAPOLIS
ST. LOUIS
Charlotte
Jamestown

unshaded areas representing points where the highest average biochemical oxygen demand observed was less than 3 parts per million.

In general, the heavily shaded areas showing biochemical oxygen demand results in excess of 3 parts per million tend to coincide fairly closely with those in figure 13 showing coliform organisms over 200 per milliliter, though they are somewhat more restricted in their extent in some portions of the map. As the biochemical oxygen demand of stream waters is affected both by sewage and by certain types of industrial wastes of an organic nature, the areas indicated in figure 14 probably show most reliably the stream zones in which the effects of combined sewage and industrial pollution are most apparent. The heaviest shaded areas denote those in which the worst conditions were observed and, in general, indicate the zones of relatively high degrees of pollution. Areas in which the average biochemical oxygen demand was not greater than 3 parts per million tend to coincide with those of figure 13, though some minor differences are indicated. In general, they represent stream zones in which sanitary conditions are good and, except for acid pollution in certain limited sections, are relatively free of objectionable pollution precluding their use for normal purposes. The fair agreement between these areas tends to confirm the tentative conclusion that stream waters in good sanitary condition should ordinarily show an average biochemical oxygen demand not over 3 parts per million.

Dissolved oxygen.—Figure 15 presents the dissolved-oxygen results divided into areas in which the lowest average content of the streams was not less than 6.5 parts per million, between 5 and 6.5, between 3 and 5 parts per million, and less than 3 parts per million, the latter being indicated by the heavier shading. An average of 6.5 parts per million, assuming a 5 parts per million minimum on any 1 day, has been suggested as a safe minimum average for the maintenance of native fish life. The greater extent of these areas as compared with the others of this figure probably is due in part to the fact that a considerable number of dissolved-oxygen observations were made during the colder months, when organic decomposition in the stream was retarded and dissolved-oxygen levels were higher than they would be expected to be under summer conditions. Because of this, figure 15 probably shows a more optimistic picture in this respect than would be justified by observations carried out over the entire basin under summer low-water conditions.

Although the heavily shaded areas are less in extent than those on figure 14, probably owing to the limitations in the proportion of summer observations previously noted, they tend to coincide with, or to be included within, the areas of relatively high biochemical oxygen demand results, thus confining within their limitations the locations of the more densely polluted streams in the basin.

Low-Flow Regulation

The stream flows of the Ohio Basin vary greatly. The minimum flow of the Ohio River at its mouth is about 8 percent of the average flow and on most of the tributaries the variations are much greater. Since the amount of water available for dilution of wastes is one of the most important factors influencing the degree of pollution, any measures which increase the minimum flow of the streams also aid in

abating pollution. Reservoirs for the storage and regulated release of natural stream waters offer the only generally practical means of low-flow regulation in this area.

Untreated municipal sewage may cause nuisance conditions even though the flow of the receiving stream is quite large because of floating solids, scum, grease, and the settling and subsequent decomposition of part of the suspended matter with accompanying odors. Hence, low-flow regulation is not a substitute for sewage treatment but an effective supplement which can be used to eliminate the need for more than primary treatment and to improve stream quality where satisfactory complete treatment methods are not available at present.

Where reservoirs expressly for low-flow regulations are proposed to replace secondary treatment, their value can be determined by the cost of the treatment eliminated. Studies of low-flow requirements and sewage treatment cost data indicate that reservoir storage capacity must be provided for not more than $15 per acre-foot if the substitution of low-flow control is to be economically justified. Experience in the Ohio Basin indicates that reservoir capacity seldom can be provided for this amount, particularly in the relatively small amounts usually required for pollution abatement. Therefore, as a general rule, low-flow regulation does not afford an economical substitute for secondary waste treatment.

If more than one source of pollution is benefited appreciably by the flow regulation, the justifiable expenditure may be increased. Thus, if by the construction of a reservoir for flow regulation, the need for secondary treatment at two, three, or more downstream places can be eliminated the allowable expenditure for storage may be increased proportionately.

Low-flow regulation can be used to reduce the maximum acidity of streams affected by acid mine drainage. It would not affect the total acid load but could reduce the damage done by acid streams. Studies of the comparative cost of mine sealing and flow regulation indicate that the allowable expenditure for storage to replace mine sealing is from about $0.50 to $2.25 per acre-foot depending on the alkalinity of the stored water.[8] Consequently, low-flow regulation cannot economically be substituted for mine sealing but it can effectively supplement it in many instances, particularly in reducing acid surges after the mine sealing program is completed.

Low-flow regulation may also afford an effective means of reducing organic pollution by industrial wastes which cannot at present be adequately controlled by treatment at reasonable cost. The economic feasibility of such control cannot be discussed in general terms.

In addition to its value for abatement of pollution low-flow regulation may be used to insure the adequacy of municipal and industrial water supplies, to improve the navigability of streams and to enhance their recreational value, and to increase the production of hydroelectric plants. Most of the reservoirs that have been constructed for low-flow regulation have been built primarily for one or more of these purposes rather than for pollution abatement.

It is apparent from these data that, in general, low-flow regulation by reservoirs built expressly for pollution abatement is not economically justified, although it may be in some cases. However, if the

[8] Alkalinity assumed to vary from 10 to 40 parts per million.

supplemental low flow can be provided incidental to some other major reservoir use in a multiple-purpose reservoir, the cost of the additional flow may be small enough to warrant inclusion of provisions for low-flow regulation in the reservoir plan. The major purposes for which reservoirs are being built or proposed in the Ohio Basin are flood control and power.

Flood-control reservoirs ordinarily remain empty or nearly so until a flood threatens and are emptied as quickly as practicable after danger has passed in order to make the storage capacity available for the next flood. Studies by the United States Engineer Department of the seasonal occurrence of Ohio River floods show that major floods occur during the late winter and early spring. The following table indicates the monthly distribution of damage from Ohio River floods at Pittsburgh.

TABLE 6.—*Monthly distribution of damage from Ohio River floods at Pittsburgh, Pa.*

Month	Average flood damage as percent of damage in maximum month	Month	Average flood damage as percent of damage in maximum month
January	22	July	1
February	32	August	1
March	100	September	6
April	12	October	1
May	2	November	2
June	2	December	3

The markedly seasonal character of Ohio River floods and the equally seasonal character of low-flow occurrences suggest the possibility of using a portion of the capacity of the flood-control reservoirs after the end of the flood season for storage of water to be released during the late summer and early fall months when stream flow is usually lowest. The United States Engineer Department has investigated the practicability of such operations and found that at many of the proposed and existing flood-control reservoirs in the Ohio Basin as much as one-third of the flood-storage capacity can be used for low-flow regulation from April 15 to December 1 without appreciably reducing the degree of flood protection. In reservoirs whose capacities are limited to less than the amount necessary for control of the major floods such encroachment on the flood-storage capacity is not considered feasible.

Hydroelectric reservoirs usually store water during periods of high stream flow and release it during dry periods. The amount of water released is usually dependent on the power demand. Low-flow regulation for other purposes can often be included in the program of reservoir operation without interfering greatly with power production.

The possibility of using existing or proposed reservoirs in the Ohio Basin for low-flow regulation has been considered and discussions of various projects are included in the basin summaries and in the section of the report on acid mine drainage. A number of areas have been found where low-flow regulation could be of considerable value for pollution abatement and water supply.

Administration of Pollution Abatement

Stream pollution is a problem of national concern. Responsibility for its abatement is primarily local. Power to require its abatement rests with the States, the Federal Government having little authority in this field. All of the States have adopted laws of some kind for the purpose of controlling pollution, and, in addition, the common law affords remedies to injured parties. Because the problem is technical and one requiring constant attention, the States have delegated power to administer the laws to some State agency, usually the health agency, since the protection of the public health is usually the primary purpose of pollution abatement. The progress that has been made varies from State to State. A survey of State laws, their administration, and the organization of the administrative agencies has been made to determine what effect laws and their administration have had on the progress of pollution abatement and to determine what steps might be taken to accelerate progress.

This survey indicates that more important than a stringent antipollution law is the existence of an adequately staffed agency carrying on an effective educational and promotional program. Education, with its concurrent awakening of the public consciousness to the value of clean streams and promotion of remedial works' installation are the foundations of a stream sanitation campaign. A campaign based upon these two factors will attain a substantial measure of success without the legal authority necessary to require the installation of remedial works. However, an impasse is finally reached when the authority must be employed if the program is to proceed.

The law should centralize authority over stream pollution in one State agency, authorized and qualified to consider the effects of pollution on all water uses, and not limited to its effects on the public health. No type of wastes and no area should be excepted from the provisions of the law. The agency should be delegated power to function administratively and to enforce the law without the continual necessity of time-consuming court action. It should be given the power to define pollution and the power to seek injunctions when necessary to protect the public interest. It should be permitted to carry out fact-finding investigations relative to pollution. Findings of fact are essential in all actions, particularly in case of court review. The agency should be permitted to prepare a program for pollution abatement and should have authority to require proper operation of remedial works.

Legal restrictions on the bonding or taxing power of municipal corporations have deterred the installation of sewage-treatment works. Provisions for financing these works by revenue bonds and sewer-rental charges have aided greatly in overcoming these restrictions. The State administrative agency should be given the power to require municipalities to utilize all means at their disposal to finance the construction of treatment works that have been found by the agency to be necessary. Provision should be made for the formation of sanitary districts to construct and operate treatment works.

In none of the States in the Ohio Basin are all of the above provisions in effect. Outstanding defects are the exemptions of acid mine drainage from control in Pennsylvania, West Virginia, and Ohio,

and the lack of authority of Ohio, Indiana, and Illinois over wastes from Ohio River communities.

Organization.—In several of the States surveyed, more than one State agency is empowered to enforce pollution abatement laws. A comparison of the ease and efficiency of operation in these States with that in other States with centralized control clearly indicates the advisability of the latter method. In this manner, responsibility is centralized and complete coverage of the problem without duplication of effort can be assured at a minimum of expense.

There is an increasing tendency to view pollution abatement in its broad perspective; namely, as an effort to promote the full utilization of a vital natural resource. For this reason it is necessary that the administrative agency not limit its activities solely to pollution affecting the public health or interfering with fish life. It should be permitted by law and qualified technically to act against pollution affecting any phase of water use. The type of organization best suited to do this cannot be stated categorically.

A number of States in the Ohio Basin and elsewhere have placed authority in a sanitary water board, a State water commission or some similar agency. Such a body includes representatives of all official agencies concerned with water pollution and occasionally representatives of industry and sportsmen. In this manner all interested parties are given a voice in the establishment of policies and feelings of animosity so often present are minimized.

Another method of achieving the desired coordination is by the establishment of an advisory board. This scheme has not been adopted in any of the States in the Ohio Basin but it has been suggested by a number of authorities. Administration would be centered in one existing agency already vested with authority. This agency would be advised as to policies and procedures by a commission including officials of State agencies concerned with water problems and representatives of industry and sportsmen. The commission may be supplemented by local watershed advisory boards throughout the State consisting of representative citizens interested in local improvement and good stream sanitation.

This type of organization takes from some agencies control which they might otherwise have and substitutes merely advisory authority. Unless a high state of interest is maintained, something which is difficult of attainment in this particular field, the interest of the advisory committee is apt to lag and its influence diminish or entirely disappear. Whether or not such a scheme would be successful would depend to a very large degree upon the executive and organizing ability, personality, and farsightedness of the head of the enforcement agency.

The most common practice is to make the State health agency the administrative agency for pollution-abatement laws. The sanitary engineering divisions of these agencies are usually the ones most actively engaged in pollution-abatement work and are better qualified technically than any other one agency to carry on such activities. The protection of water supplies from pollution is of definite concern to the health department. The effects of pollution on streams used for recreation are also of interest to the health agency. In practically all States the health department has been delegated authority either to supervise pollution-abatement work or to advise cities and industries with reference to their waste-disposal problems. By virtue of their

functions and experience, State health agencies should have considerable authority in any organization for the administration of pollution abatement. In most sanitary water boards, the State sanitary engineer is executive secretary of the board and the most active individual member. Under the advisory board scheme, the health agency is usually the administrative agency. In those cases where there is no legal provision for coordination of the views of all interested agencies and parties and the health agency alone is given authority, the coordination can be achieved unofficially if the agencies and individuals concerned are not unduly jealous of their positions, prerogatives, and programs.

In short, the exact type of organization is not highly significant. It is much more important that the agency be adequately financed and properly staffed with trained men familiar with pollution problems and their relation to all phases of water use. Personality and enthusiasm are as important as technical ability. The agency must be able to carry on an effective educational and promotional program and to work without friction with municipal and industrial officials. A minority of recalcitrant individuals and officials can be dealt with by legal action but effective policing to enforce an unpopular law would require so many men that the entire scheme would be impractical.

Authority.—In some instances cooperation can be obtained only if there is some legal power or authority which might be used. In other instances actual use of authority is necessary. The State administrative agency should have the following powers:

(*a*) Power to define what constitutes pollution, with the definition based on consideration of all phases of water use.

(*b*) Authority to investigate pollution on its own initiative. Investigation of all complaints to the agency should be mandatory.

(*c*) Power to review all sewerage plans and plans for new industrial waste outlets and to require suitable treatment.

(*d*) Power to issue orders against polluters, requiring abatement of pollution.

(*e*) Power to seek injunctions when necessary to protect the public interest.

(*f*) Control over the operation of remedial works.

All of these powers are designed to promote rapid and efficient solution of the problem with a minimum of litigation. The actions of the agency would be subject to court review as are the actions of any other administrative agency.

The basic law may well define pollution in general terms but the agency should be given the power to define in more precise terms what will be considered actionable pollution. The definition should be broad enough to include pollution which would interfere unduly with any water use and definite enough to enable municipalities and industries to determine what may be expected of them. No exceptions should be made in the basic law as to either areas or types of wastes subject to the control of the administrative agency, but the agency should not be required to apply a uniform standard of quality to all streams in the State or to all wastes of a given type.

The agency should be permitted to make all fact-finding surveys and investigations. Findings of fact are highly important, not only to serve as a basis for recommendations and orders but also to support

the agency in possible cases of court review. These surveys and investigations should be permitted without having to wait for a complaint. The agency should be given the right of access to municipal and private property necessary to make surveys and investigations. Only in this way can a comprehensive plan and program be developed. The requirement that all complaints must be investigated and reported on is a valuable aid in securing public approval of the program.

The power of review of all plans for new work involving increases in waste discharges enables the agency to prevent any important increases in pollution while engaged in its programs of abatement of pollution from existing sources. To make this power effective, the agency should be able to make rules and regulations governing sewerage and industrial waste treatment. Most of the States with effective pollution abatement programs have given this power of review to the administrative agency.

The power to issue orders requiring the abatement of pollution has been an extremely valuable instrument in many States. The basic law should outline the procedure to be followed in issuing such orders and provide for the enforcement of them. In general, the procedure is as follows:

(*a*) The agency makes an investigation to determine whether or not actionable pollution exists.

(*b*) If such pollution is found to exist the offender is cited to appear before the agency for a hearing and show cause why an order should not be issued requiring the abatement of the pollution.

(*c*) If the offender cannot show sufficient cause, an order is entered requiring the treatment or complete elimination of the waste discharge causing pollution.

This procedure is much more economical of time and money, and requires less litigation than if the agency were required to seek action through other legal channels.

Occasionally, even this type of machinery is too slow to protect properly the public interest. This is particularly true in the case of seasonal industries, when ponded wastes are suddenly discharged, or when remedial devices are improperly operated. The agency should be able to take action by injunction or otherwise to prevent such pollution.

To insure the proper operation of treatment plants and other remedial works, the State administrative agency should be empowered to supervise their operation and to make the necessary rules and regulations. The agency should be adequately and properly staffed to permit it to assist municipalities and industries in the solution of operating problems.

Sanitary districts.—Legislation to allow the easy formation of sanitary districts to serve unincorporated areas or combinations of one or more municipalities and adjoining areas is necessary if one of the more troublesome and difficult to control pollution sources, the private sewer, is to be eliminated and if pollution abatement work is to be carried on most economically and effectively in metropolitan areas. Most States have made some provision for such districts but, in many instances, the formation and preliminary financing have been made so difficult that the law is seldom used. In one State, 90 percent of the property owners concerned must sign the petition for the district's formation. Illinois has used the sanitary district method with con-

siderable success. Reasonable legislation could facilitate the formation of districts and still protect against the formation of additional unnecessary governmental units.

The administrative agency may well be given power to review plans for the formation of districts and the power to order the formation of districts where this appears to be the only feasible solution to a pollution problem, as in the case of unincorporated areas on the fringes of municipalities. Ohio's administrative agency has this authority with reference to county sewer districts and the program in the State has been materially assisted by the authority. In most other States individual prosecution, a cumbersome device at best, must be either used or threatened to accomplish district formation in such cases.

Financing.—Constitutional and statutory limitations on the bonding and taxing power of cities have hindered the installation of remedial works in many instances. If a pollution abatement program is to proceed some means must be found, consistent with sound financial policy, to overcome these difficulties. The principle of allowing municipalities to exceed these limitations upon order of the administrative agency might be applied to statutory limitations but where the limitations are imposed by the constitution, this would probably not be feasible. In some States the municipalities are forbidden to issue bonds for other purposes so long as a State order requiring the installation of pollution abatement works has not been complied with. Provision may also be made for revenue financing of sewage works, permitting the assessment of sewer service charges. This is an equitable method of financing such works and has been used in a large number of cases in recent years. A recent adverse Pennsylvania court decision in the case of Philadelphia, which is up to its debt limit, ruled against determining sewer rental charges on the basis of the assessed valuation but at the same time stated that a charge based on a proportion of the water charge was proper.

Administrative policies.—In investigating the administration of pollution abatement, a number of policies were encountered which have met with a great deal of success. In general, it was found that the agencies which have been most successful have been relatively slow to use the courts or administrative orders to force action. Much of their effort has been devoted to arousing public consciousness of the value of clean streams and securing public support for remedial measures. They try to cooperate and consult with municipalities and industries in order to work out the most satisfactory solution of individual problems.

A practically universal policy at the present time in the Ohio Basin is that no new sewers may be installed unless treatment is provided. Some States even require that no additions may be made to existing sewer systems without provision for treatment. The Works Progress Administration has aided in effectuating such policies by refusing to approve sewerage projects without treatment except in special cases.

Another policy that has been helpful in hastening progress is that of informing injured riparian owners of their rights. The technical knowledge of the enforcement agency can be of great value to the individual owners who seldom have the means of getting the necessary information for the successful prosecution of a lawsuit.

Much of the routine work of the State administrative agencies is concerned with securing proper operation of remedial works after

they have been installed. The common tendency to consider the problem as solved once the treatment plant has been constructed must be combated continually. The agency must be adequately staffed to permit the frequent inspection of remedial works and to aid plant operators in solving their problems. Most States have adopted the policy of requiring submission of rather complete records of plant operation. Some States offer prizes to those operators submitting the best records.

In order to stimulate interest in the problems of plant operation and to improve the standards of operation, a number of States have conducted or sponsored short schools and conferences for operrators. Most of the operators of the smaller plants have little or no technical education and these schools have been instrumental in giving such men an understanding of the scientific principles underlying efficient plant operation. In addition, such schools enable the men to meet each other, to discuss their common problems and exchange experiences.

Another step that has been taken to improve the caliber of plant operators is the licensing of operators by the State administrative agency. As a rule, the licensing plan operates similarly to licensing of stationary engineers with several grades of licenses and requirements as to education and experience, as well as an examination. Licensing has been helpful in improving the tenure of competent operators and in attracting better trained men to such jobs.

Interstate waters.—As in the case of other water problems, the difficulty of dealing with pollution of interstate streams has cast doubts on the effectiveness of State control and brought forth demands for Federal action. Progress has been made in certain areas in the solution of some interstate pollution problems but, in general, much less has been done than where the problems were primarily intrastate and subject to the control of a single agency. The Ohio River is a striking example of this.

Informal interstate agreements have been effective in reducing tastes and odors in Ohio River water supplies but no appreciable progress has been made in reducing sewage pollution of the river. Much of the difficulty is due to the lack of jurisdiction of the States north of the river over the stream. The Ohio River Valley Water Sanitation Compact has been drafted by compact commissioners of the States involved, approved by the Congress, and ratified by four of the State legislatures (Indiana, New York, Illinois, and Kentucky) unconditionally. The Ohio and West Virginia Legislatures have ratified the compact but their action does not become effective until the Pennsylvania Legislature also ratifies. Considerable progress has been made in Pennsylvania toward ratification of the compact, one branch of the legislature having passed ratification legislation on two occasions.

The personnel of the Ohio River Valley Compact Commission that drafted the compact is of particular interest. Represented on this commission were the administrative or technical heads of the pollution administrative agencies of the States bordering on the Ohio River. These representatives had been engaged in administering pollution-control laws for a great many years and some of the most notably successful pollution-control programs of this country have been due to their efforts. The compact, as finally approved, repre-

sents the consensus of these successful, experienced administrators in their efforts to prepare a practical workable document. An outline of the provisions of the compact is included in the summary dealing with the main Ohio River.

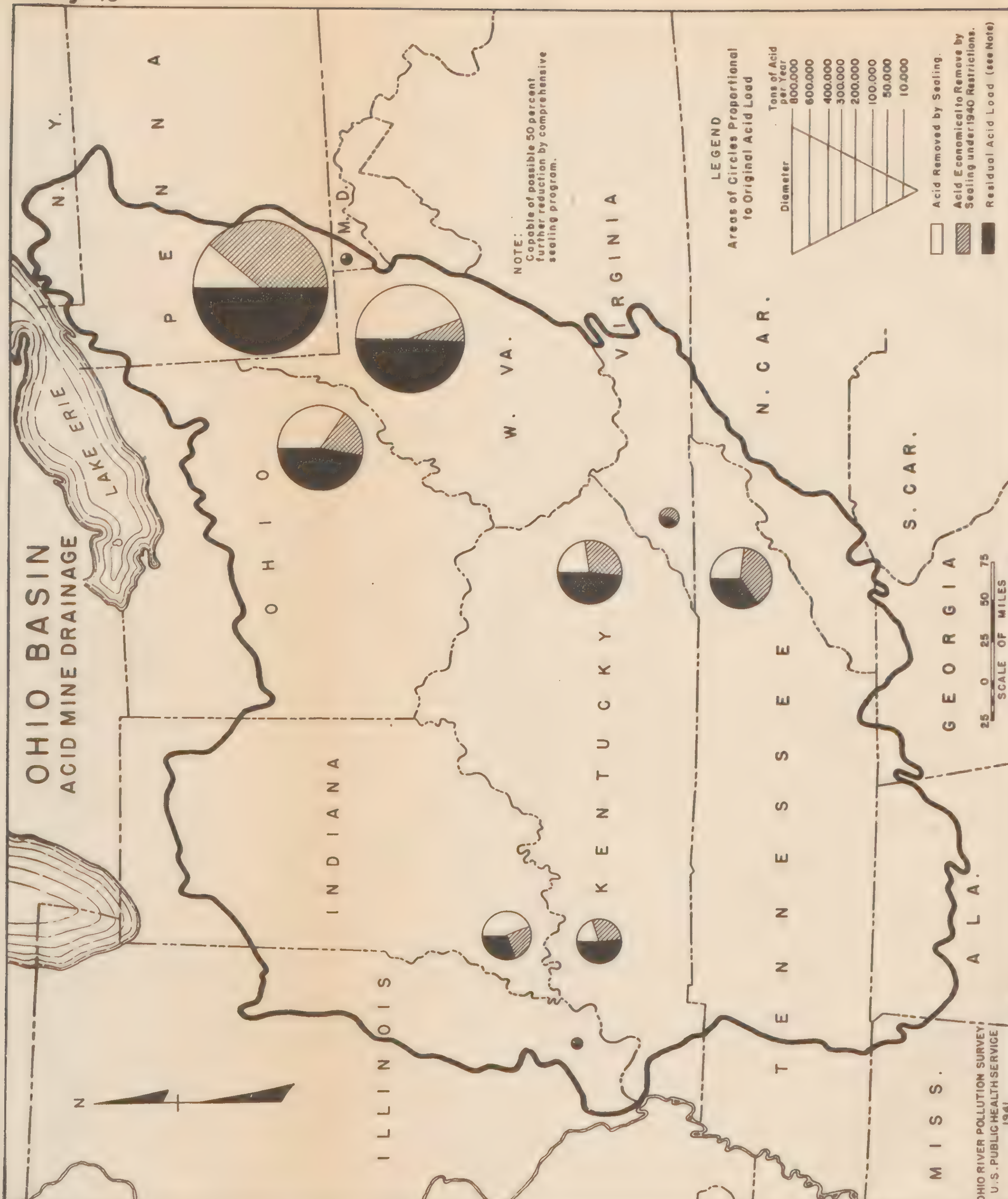
Two interstate compacts dealing with water pollution have been in effect for several years. The one between New York and New Jersey dealing with the problems of the metropolitan area of New York has been fairly successful. The one between North Dakota, South Dakota, and Minnesota on the Red River of the North has accomplished little. A third, the Potomac Compact, adopted by Maryland, Virginia, West Virginia, and the District of Columbia created the Potomac Valley Conservancy District, organized formally in October 1941. Activities to date have been confined to a preliminary assembling of available data. The formation of these compacts may be taken to indicate a trend but none of them are sufficiently comparable to serve as a basis for predicting the success of this method in the Ohio Valley as a means of abating water pollution.

Progress has been made in pollution abatement in the Delaware River Basin since the establishment of the Interstate Commission on the Delaware (Incodel) in 1936. This commission derives its authority from joint legislative commissions on interstate cooperation established by the four States of the basin. No interstate compact is involved. Standards of quality for effluents discharged to various zones of the basin have been agreed upon by the four States and a general plan drawn up for treatment of municipal wastes. Progress has also been made in construction of sewage treatment works. Financial difficulties have deterred construction of such works at Philadelphia, the key to the solution of the water pollution problem of the basin.

Most interstate compacts in the past have dealt with matters which once settled require little further attention, such as boundary disputes. Compacts have been fairly successful in settling matters of the apportionment of water in interstate streams in the section of the country where irrigation is important. The Ohio River Valley Water Sanitation Compact is the first to be negotiated dealing with a continuing and complex problem in a large area and its success or failure will probably have considerable influence on future attempts at controlling pollution of interstate waters. It is highly desirable that the compact be ratified.

Federal interest.—The increasing activity of the Federal Government in other fields of water use and control, together with the lack of progress being made in the solution of interstate pollution problems in some areas have been responsible for a number of proposals of Federal legislation on the subject. The proposals have been of two general types; one providing for Federal technical and financial aid to States and administrative agencies and financial aid to municipalities and industries in the construction of pollution abatement works; the other providing for similar aid to municipalities and industries and, in addition, for Federal control over the pollution of interstate waters. The need for financial assistance if the work is to proceed rapidly has been shown by the effect of Federal aid on the rate of progress of sewage treatment in recent years and is generally recognized. The need for Federal exercise of police power, however, has been bitterly contested. The disagreement is not one that can be

Fig.-16



(Face p. 191) GPO-43 0-90035

resolved by findings of fact at the present time. It involves problems of governmental policy not within the scope of this survey. The findings of this survey do indicate a need for something more than the present degree of control over pollution of the Ohio River. The compact provides a method for this control, through the utilization of existing, experienced State agencies working together with Federal assistance. Whether or not this method is efficient and effective can be decided only after a trial.

The Federal Government can encourage such efforts by making available advisory and technical assistance. The present survey should provide the basis for a program of control when and if the Ohio River compact becomes effective.

Acid Mine Drainage Studies

Acid drainage from coal mines affects the streams throughout the area covered by the Ohio River Basin coal fields (see figure 3). In Pennsylvania and West Virginia, the two largest bituminous coal producing States, the problem dominates the stream sanitation picture. The present situation exists despite the fact that in these two States only 5.1 percent of the coal deposit has been mined out or lost. The present survey has conducted a study of the basic theories of acid formation in coal mines and the possibilities and experience with remedial measures. Particular attention has been directed to control measures involving mine sealing and flow regulation, particularly by multiple purpose use of flood-control and other purpose reservoirs. Studies and demonstrations by the United States Bureau of Mines of the possible accomplishments of mine sealing have shown that acid control at the mine is practical at reasonable cost, and a start, made in the form of a Works Progress Administration program (see figure 16) of sealing abandoned mines with United States Public Health Service and State cooperation, has confirmed (see figure 17) the earlier work. The present sealing program, however, is not a continuing activity, having been discontinued from time to time in some States. Provision for essential maintenance is lacking. Flow regulation by flood-control reservoirs built by the United States Engineer Department has had a beneficial effect. Aggressive prosecution of a suggested remedial program is amply justified, particularly in the Pittsburgh district where tangible monetary benefits can be shown in excess of remedial costs. Remedial measures are imperative to insure the future of the principal streams in the mining areas.

The question of acid mine drainage has been made the subject of a detailed supplement to this report and consideration here is confined to summarized information and conclusions.

ACID LOAD REDUCTION BY SEALING

Mine acid loads in the major tributaries of the Ohio River Basin as originally measured and after present sealing and suggested sealing under 1940 restrictions are given on figure 16 and table 7.

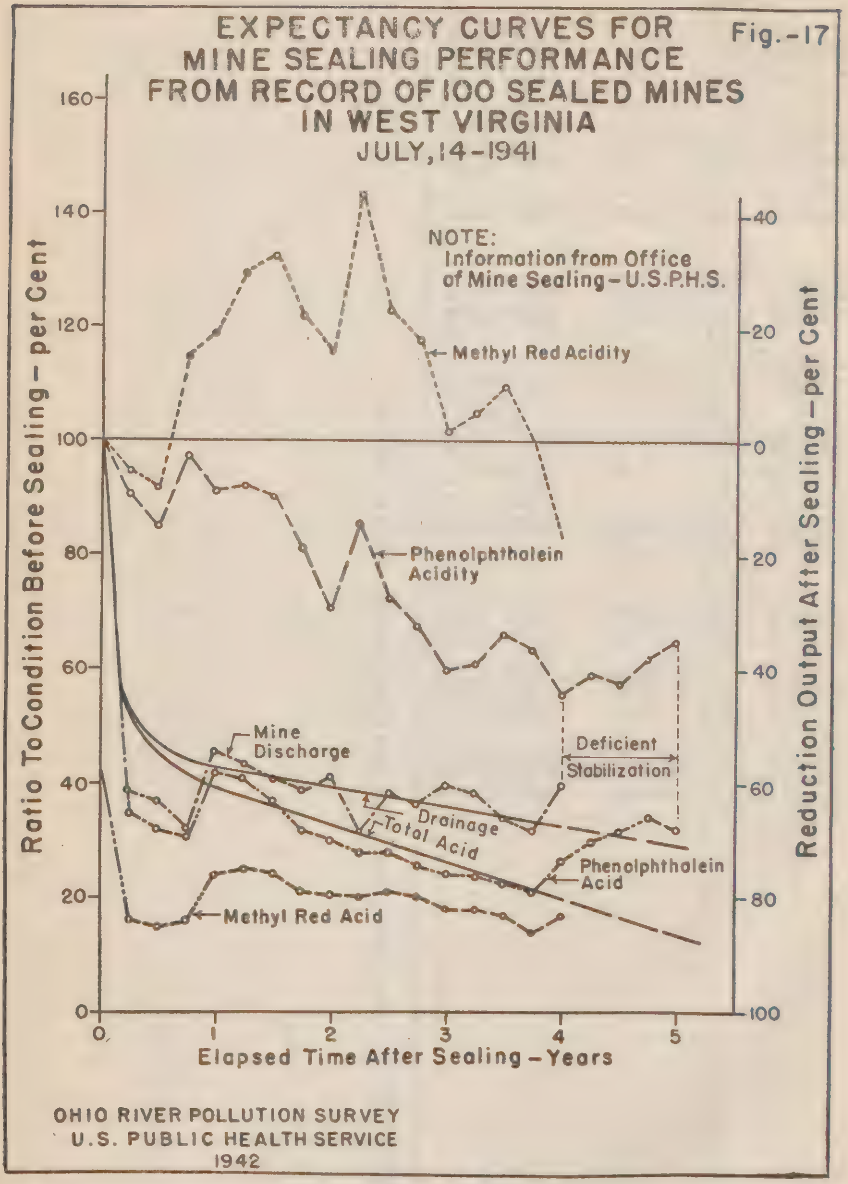
90035—44—pt. 2——4

TABLE 7.—*Acid mine drainage. Summary by tributary drainage basins and States of original classified mine acid loads, intensity per square mile, acid removed by sealing, estimated acid economical to remove under 1940 restrictions, and residual mine acid loads.*

Tributary drainage basin and State	Drainage area, square miles	Original acid load as $CaCO_3$: Active mines, tons per year	Original acid load as $CaCO_3$: Marginal[1] mines, tons per year	Original acid load as $CaCO_3$: Abandoned mines, tons per year	Total mines: Tons per year	Total mines: Tons per square mile per year	Sealed mines: Original acid load, tons per year	Sealed mines: Efficiency, percent	Acid removed by sealing, tons per year	Economical to remove in addition by sealing, tons per year	Residual acid load after sealing under 1940 restrictions[2]: Tons per year	Residual acid load after sealing under 1940 restrictions[2]: Percent
Allegheny River except Kiskiminetas	9,838	26,457	6,760	50,244	83,461	8.5	24,040	78	18,750	32,330	32,381	39
Kiskiminetas River	1,892	223,896	23,805	73,988	321,689	170.0	20,270	54	10,954	132,630	178,105	55
Allegheny River total	11,730	250,353	30,565	124,232	405,150	34.5	44,310	67	29,704	164,960	210,486	52
Monongahela except Youghiogheny	5,648	438,274	39,064	223,634	700,972	124.1	380,026	66	251,900	115,630	333,442	48
Youghiogheny River	1,732	141,735	25,609	52,340	219,684	126.8	29,270	78	22,742	83,050	113,892	52
Monongahela River total	7,380	580,009	64,673	275,974	920,656	124.7	409,296	67	274,642	198,680	447,334	49
Beaver River	3,145	5,480	988	10,920	17,388	5.5	5,376	42	2,280	6,500	8,608	50
Little Kanawha River	2,320	323	2	493	818	0.4	716	65	470	50	298	36
Kanawha River	12,300	9,210	995	22,650	32,855	2.7	21,157	65	13,750	2,170	16,935	52
Guyandot River	1,670	15,680	614	3,890	20,184	12.1	14,333	65	9,320	1,330	9,543	47
Big Sandy River	4,280	16,236	8,997	35,699	60,932	14.2	26,324	56	14,738	18,320	27,874	46
Muskingum and Hocking River	9,225	37,700	14,600	163,500	215,800	23.4	170,000	54	91,400	19,000	105,400	49
Scioto River	6,510	4,900	2,400	16,800	24,100	3.7	11,540	54	6,230	7,100	10,770	45
Little Miami River	1,755	0	0	0	0	0	----	----	----	----	0	
Licking River	3,670	----	----	----	Slight	----	----	----	----	----	0	
Miami River	5,385	0	0	0	0	0	----	----	----	----	0	
Kentucky River	6,940	10,900	3,200	27,800	41,900	6.0	22,865	50	11,433	9,520	20,947	50
Salt River	2,890	0	0	0	0	0	----	----	----	----	0	
Green River	9,220	26,500	7,900	42,100	76,500	8.3	30,230	50	15,115	23,140	38,245	50
Saline River	1,235	----	----	----	Slight	----	----	----	----	----	0	
Tradewater River	995	3,000	1,500	3,400	7,900	7.9	1,730	50	865	3,270	3,765	48
Cumberland River	18,000	53,610	13,045	198,115	264,770	14.7	105,056	65	68,862	93,070	102,838	39
Tennessee River	40,600	4,960	1,145	32,063	38,168	0.9	20,239	80	16,200	10,770	11,198	29
Wabash River	33,100	26,777	3,174	79,631	109,582	3.3	54,054	87	47,040	30,403	32,139	29
Main Ohio River:												
Pennsylvania	1,290	27,380	11,320	10,697	49,397	38.3	14,100	64	9,030	15,050	25,317	51
Ohio	6,450	21,100	7,400	85,000	113,500	17.6	45,820	54	24,750	40,200	48,550	43
West Virginia	3,005	7,579	764	18,464	26,807	8.9	14,028	65	9,120	1,770	15,917	59

Kentucky [2]	5,680	4,700	1,300	11,200	17,200	3.0	7,854	50	3,927	4,900	8,373	49
Indiana	3,480	2,978	64	10,013	13,055	3.8	6,964	87	6,060	496	6,499	50
Illinois	1,645	356	1,804	411	2,571	1.6	305	70	214	1,000	1,357	53
Main Ohio River total	21,550	64,093	22,652	135,785	222,530	10.3	89,071	60	53,101	63,416	106,013	48
Unclassified—Virginia	7,175				18,750	2.6	0		0	11,070	7,680	41
Total Ohio River Basin	203,900	1,109,731	176,450	1,173,052	2,477,983	12.2	1,026,288	64	655,150	662,769	1,160,064	47
Alabama	6,810	0	0	0	0	0					0	
Georgia	1,490	0	0	0	0	0					0	
Illinois	11,440	356	1,804	411	2,571	0.2	305	70	214	1,000	1,357	53
Indiana	29,135	29,775	3,238	89,644	122,637	4.2	61,018	87	53,100	30,899	38,638	32
Kentucky	39,375	88,900	31,700	180,000	300,600	7.6	129,000	50	64,500	89,500	146,600	49
Maryland	430	535	79	847	1,461	3.4	570	60	342	400	719	49
Mississippi	385	0	0	0	0	0					0	
New York	1,955	0	0	0	0	0					0	
North Carolina	6,260	0	0	0	0	0					0	
Ohio	29,570	65,000	25,000	270,000	360,000	12.2	229,600	54	123,590	68,900	167,510	46
Pennsylvania	15,620	521,513	90,003	277,833	889,349	56.9	128,237	72	91,804	349,560	447,985	50
Tennessee	33,645	25,170	5,190	160,478	190,838	5.7	74,771	80	59,800	72,440	58,598	31
Virginia (unclassified)	7,175				18,750	2.6	0		0	11,070	7,680	41
West Virginia	20,610	378,502	19,436	193,839	591,777	28.7	402,787	65	261,800	39,000	290,977	49
Total	203,900	1,109,731	176,450	1,173,052	2,477,983	12.2	1,026,288	64	655,150	662,769	1,160,064	47

[1] Not completely abandoned.
[2] Areas connected to active ventilation systems and areas where costs exceed $10 per ton per year not included.


EXPECTANCY CURVES FOR
MINE SEALING PERFORMANCE
FROM RECORD OF 100 SEALED MINES
IN WEST VIRGINIA
JULY, 14-1941
Fig.-17
NOTE:
Information from Office
of Mine Sealing - U.S.P.H.S.
Methyl Red Acidity
Phenolphthalein
Acidity
Mine
Discharge
Drainage
Total Acid
Deficient
Stabilization
Phenolphthalein
Acid
Methyl Red Acid
Ratio To Condition Before Sealing - per Cent
Reduction Output After Sealing - per Cent
Elapsed Time After Sealing - Years
160
140
120
100
80
60
40
20
0
40
20
0
20
40
60
80
100
0
1
2
3
4
5
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1942

Total basin acid loads from this table and the estimated load following a sealing program with 1940 restrictions modified are as follows:

	Tons per year
Original mine acid load	2, 500, 000
Reduction, to date, by sealing	700, 000
Present mine acid load	1, 800, 000
Possible further reduction by sealing under 1940 restrictions	600, 000
Load after sealing under 1940 restrictions	1, 200, 000
Possible further reduction with 1940 restrictions modified	600, 000
Estimated ultimate residual load	600, 000

The sealing program under 1940 restrictions is based on a cost limitation of $10 per ton of acid per year and sealing only in areas not connected to active ventilation systems. Modified restrictions would permit sealing operations in worked-out sections of active mines.

The cost and benefit estimates, discussed later, apply to work necessary to complete a sealing program under 1940 restrictions and the report discusses this completion as a first objective.

Free mineral acid from waste pickle liquor is estimated at 3.4 percent of the present total free and combined mine acid load. Acid from hydrolized iron sulfates may be minor or as high as 10 times this quantity depending on the hydrolysis equilibrium.

MINE SEALING COSTS

Mine sealing costs to date in the Ohio River Basin, as shown in table 8, have been about $5,400,000. To complete a sealing program under 1940 restrictions will cost an estimated additional $5,500,000. Annual charges of interest (3½ percent), amortization (0.7 percent based on 3½ percent interest and a 50-year life), inspection (2 percent) and maintenance (7 to 10 percent) are about 15 percent or $1,635,000 on the total of these two sums of $10,900,000. This is about 4 mills per net ton of production and confirms an estimate of the Office of Mine Sealing, United States Public Health Service. These and other estimates of future mine sealing costs are believed conservatively high as they are based primarily on past experience with Works Progress Administration programs with the dual purpose of providing relief and improving mine acid conditions.

MINE-ACID-CONTROL PROGRAM

Present information indicates that correction, in large measure, of the mine-acid-pollution problem is practical by a comprehensive control program involving the following measures:

(*a*) Provisions for the inspection and maintenance of present air seals and a similar provision in connection with all future mine-sealing programs.

(*b*) Completion of the present limited (1940 restrictions) mine-sealing program.

(*c*) Provision of reservoir capacity, presumably in primarily flood-control reservoirs, for flow regulation for acid and organic-pollution control.

(*d*) Inauguration of an aggressive program of mine sealing with present restrictions modified.

(*e*) Adaptation of the better mining methods to acid control.

(*f*) Extension of the established practice of refraining from discharging acid waters to streams previously uncontaminated.

(*g*) Clarification of the laws governing mine drainage to facilitate the corrective program.

TABLE 8.—*Acid mine drainage: Cost of Works Progress Administration program of mine sealing to date and estimated to complete restricted mine-sealing program, both State-wide and for the Ohio River Basin*

State	State-wide expenditures			Ohio Basin expenditures	
	Total to date [1]	Per ton per year of acid sealed	Estimated to complete program	Estimated total to date [1]	Estimated to complete program
	By States				
Illinois	$12,000	$7.28		(2)	
Indiana	273,000	4.48	$80,000	$270,000	$80,000
Kentucky	340,000	2.66	1,200,000	340,000	1,200,000
Maryland	221,000	8.25	50,000	10,000	
Ohio	1,935,000	8.40	400,000	1,940,000	400,000
Pennsylvania	2,666,000	11.50	4,000,000	1,490,000	3,100,000
Tennessee	109,000	2.46	420,000	110,000	420,000
Virginia	0		150,000	0	150,000
West Virginia	1,462,000	3.00	200,000	1,210,000	160,000
Total	7,018,000	5.80	6,500,000	5,370,000	5,510,000

Basin	By basins	
Minor tributary basins	$650,000	$480,000
Allegheny	510,000	1,460,000
Monongahela	1,820,000	1,600,000
Beaver	60,000	50,000
Muskingum and Hocking	1,450,000	110,000
Kanawha	70,000	120,000
Guyandot	40,000	10,000
Big Sandy	70,000	240,000
Scioto	100,000	40,000
Kentucky	60,000	130,000
Green	80,000	310,000
Wabash	240,000	80,000
Cumberland	200,000	780,000
Tennessee	20,000	100,000
Total	5,370,000	5,510,000

[1] Rounded. [2] Less than 5 000.

UPPER OHIO BASIN

For illustrative purposes and to indicate cost to benefit relationships, special studies have been made in the upper Ohio River Basin area or the area above the Ohio-West Virginia-Pennsylvania State line. Estimates have been made of accomplishments, costs, and benefits resulting from application of the first three of these items, namely, mine sealing, maintenance, and flow regulation. Any study of reservoir development should include consideration of organic-pollution control and the program studied considers both organic and acid pollution.

Damages.—Damages capable of monetary evaluation caused by acid mine drainage include neutralization and softening costs to domestic and industrial water supplies and corrosion of steamboats, barges, power plant condensers, and river and harbor structures. These damages in the area above the Ohio-West Virginia-Pennsylvania State line, totaling about $2,000,000 per year, are shown on table 9. Equally important, but intangible or unevaluated, damages, are to

water supply due to manganese, to recreation through the destruction of normal aquatic life, to agricultural uses, to highway structures, to the mines themselves, and indeterminate but serious damages to the public health due to rapid fluctuations in quality as reported by water-plant operators. Mine acid is a deterrent to organic pollution abatement as incentive for abatement measures is lacking if the result is a stream suitable only for disposal of mine waters. Mine acid is not a safeguard to public water supplies as the rapid increase in flow during a freshet may bring sufficient alkalinity to neutralize the acidity and eliminate any germicidal effect there may be.

TABLE 9.—*Acid mine drainage: Summary, as of 1940, of annual damages, capable of accurate estimation and caused by acid mine drainage above the Ohio-West Virginia-Pennsylvania State line*

	Total annual damages
Domestic water supplies	$364,000
Industrial water supplies	407,000
Steamboats and barges	1,143,000
Power plants	76,000
River and harbor structures	76,000
Floating plant (U. S. Engineer Department)	5,000
Total, 1940	2,071,000
Future estimate (based on estimated future quality but no increase in use):	
1950	2,630,000
1960	3,190,000

Mine sealing.—Data on mine acid loads before and after various stages of sealing, similar to that given on table 7, for the upper Ohio River Basin are as follows:

	Tons per year
Original mine acid load	1,375,000
Reduction, to date, by sealing	313,000
Present mine acid load	1,062,000
Possible further reduction by sealing under 1940 restrictions	379,000
Load after sealing under 1940 restrictions	683,000

The completion of a mine-sealing program in this area under 1940 restrictions will cost an estimated $3,250,000. Annual charges, including interest, amortization, inspection, and maintenance as already enumerated, are 15 percent or $488,000 on this expenditure. Similar annual charges on existing mine seals of 15 percent of the approximately $2,550,000 spent on mine sealing to date in this area are $382,000 per year, making a total of $870,000 per year. As shown on figure 17, if these existing seals are not maintained, the benefits already realized may easily be lost making it necessary to repeat the expenditure.

Flow regulation.—The application of mine sealing under 1940 restrictions will greatly reduce the maximum monthly acidity but there will still remain acid surges and months in which conditions are unsatisfactory. The acid surges, particularly during times of low flow, will be a hazard to aquatic life. A further improvement during all but the highest flow months and a measure of protection against acid surges hazardous to aquatic life are possible by the application of flow regulation from reservoir storage. The estimated reservoirs selected for acid control are the largest that can be used without storing

for periods greater than 1 year. Utilization of increased capacity beyond this point would be infrequent and the unit value would therefore be reduced. Reservoir capacities selected in the upper Ohio River Basin area under these conditions are as follows:

	Acre-feet
Allegheny Basin	210, 000
Monongahela Basin	370, 000
Total	580, 000

Organic pollution in the upper main Ohio River can be controlled satisfactorily by a partial treatment of sewage and industrial wastes plus flow control adequate to eliminate those low-flow periods when a higher degree of treatment would normally be required. A second method of control would be to allow natural flows to remain unchanged and install facilities for providing the required higher degree of treatment.

In estimating the value of flow regulation for organic pollution abatement, this value was considered as equal to the difference in cost between partial treatment and the required higher degree of treatment.

The required flow has been estimated to be 8,000 cubic feet per second during the warm summer months (25° C. or 77° F. average monthly air temperature) and progressively lesser flows as temperatures decrease. With this flow regulation, primary treatment plus equivalent treatment of industrial wastes would be adequate to maintain satisfactory stream conditions for reasonable use other than domestic water supply immediately below Pittsburgh.

The question arises as to the justification of attempting to maintain such conditions during times of abnormally low flow such as occurred during 1930. Conditions of 1930 have occurred but once in a period of record of over 30 years and have not been approached in any other year. If 1930 is included, storage required for flow regulation is 830,000 acre-feet while during all other years storage of 430,000 acre-feet would be adequate. It is concluded that the cost of providing the higher storage capacity is greater than warranted by control of pollution during a drought occurring but once in 30 years. This does not mear that conditions would not be improved during an extreme drought. A valuable partial organic pollution control would be available during a year such as 1930.

Storage required for organic pollution abatement is 430,000 acre-feet (except in 1930) while total storage selected for acid control is 580,000 acre-feet. This last storage figure of 580,000 acre-feet has been used in estimating benefits.

Benefits and costs.—Benefits of the combined program due to acid control are due to a reduction in the damages detailed on table 9. Benefits to organic pollution control are due to a reduction in the cost of needed sewage and industrial waste treatment.

Reduction in maximum monthly acidities equitably assigned to the two items—mine sealing and flow regulation—of this program are as follows:

	Acidity,[1] parts per million	
	Allegheny at Aspinwall	Monongahela above McKeesport
Present monthly maximum	23	33
Reduction by sealing [2]	22	19
Reduction by reservoirs [2]	14	10
Resulting monthly maximum	(3)	4

[1] To methyl red on Allegheny and methyl orange on Monongahela.
[2] Equitably assigned or average improvement if remedy applied constructed first or second. As a rule, projects applied first show increased benefits at expense of later projects.
[3] 13 parts per million minimum alkalinity in Allegheny at Aspinwall.

The estimated monetary benefits to acid and hardness reduction in the Allegheny, Monongahela, and upper Ohio River Basin due to the suggested mine-sealing and flow-regulation programs total $1,133,000 per year. This estimate is believed conservative as it is based on 1940 damages instead of greater possible future damages and it does not include benefits to unevaluated and intangible items. Deducting the cost of sealing of $870,000 per year from these benefits leaves $263,000 per year that can be spent on reservoir construction for acid and hardness reduction.

In correcting sewage and organic industrial waste pollution without flow regulation, a higher degree of treatment (estimated as effective chemical treatment) would be required to maintain equivalent stream conditions. Estimated additional annual costs of the selected chemical treatment over primary treatment is $300,000 at Pittsburgh. Flow regulation above Pittsburgh would increase the minimum flow at Cincinnati and this increase would result in savings for similar reasons of an additional $300,000.

While the flow regulation is designed primarily for acid pollution control, minor adjustments in the operating schedule make it possible for the flow regulation also to serve as a valuable aid in organic pollution control. The two flow regulation objectives fit well together as acid discharges are at a minimum during dry periods when augmented flow is required for organic pollution control. An examination of flow and acidity records indicates that acid control and organic pollution abatement can both be accomplished with the exception of 1 month (also excepting 1930) in 10 years and this accomplishment has been taken as satisfactory.

Annual benefits to flow regulation include $263,000 left after deducting mine sealing costs from acid and hardness control benefits, plus $300,000 for organic pollution control at Pittsburgh and $300,000 for organic pollution control benefits at Cincinnati, making a total of $863,000 per year. For a storage of 580,000 acre-feet, the annual benefits or the amount that can be economically spent per acre-foot per year is $1.49.

A summary of the cost and benefit relation is as follows:

	Annual benefits and costs
Benefits, acid control	$1, 133, 000. 00
Cost, mine sealing to date and future	870, 000. 00
Balance, acid control for reservoirs	263, 000. 00
Benefits, organic pollution control:	
Pittsburgh	300, 000. 00
Cincinnati	300, 000. 00
Total available for reservoirs	863, 000. 00
Per acre-foot	1. 49

Reservoir benefits are, in large measure, due to equalizing and surge reducing effects following mine sealing in order to develop full benefits from the sealing program. The balance for reservoirs indicated is, therefore, available to the extent shown only if and when the mine-sealing program is assured. Mine sealing, on the other hand, can be justified beyond reasonable doubt as a single independent remedial measure.

Studies conducted by the Corps of Engineers disclose that storage capacity can be provided in the quantities required for low-flow control in the Allegheny-Monongahela-Upper Ohio River Basin. It is further indicated that the best development of the water resources of the basin would provide low-flow control as a function of multiple-purpose reservoir operation. Under such circumstances, the average annual benefits which could be reasonably assigned to such an improvement would be in excess of the average annual cost.

Introduction to Drainage Basin Summaries

The basic information of the Ohio River pollution survey has been presented in summaries covering the main Ohio River, minor tributary basins and the 19 major tributary basins. An effort has been made to have each summary complete in itself. Certain explanations, applicable to each, have been made in this section to avoid repetition.

Insofar as possible, information for each basin is presented in as near identical form as possible, according to the following general outline:

- Syllabus and conclusions.
- Description.
- Presentation of field data.
- Presentation of laboratory data.
- Hydrometric data.
- Discussion.

Accompanying the text are a number of tables, maps, and charts. With the exception of the division on the main Ohio River, similarly numbered tables and figures cover similar material in each basin summary.

In the tabulations of costs (table 1) the annual charges are based on interest rates of 3½ percent for municipal and 5 percent for industrial construction and periods for amortization of 40 years for interceptors, 20 years for municipal treatment plants and 10 years or less for industrial corrective measures. Studies of interest rates and

life of treatment facilities have indicated that these figures represent about the average experience of municipalities and industries. Cost estimates of individual projects are not shown except in a few cases where they are based on engineering surveys. Since most of the estimates are not based on detailed studies of each situation they may be considerably in error in individual instances. Grouped for an entire basin, the probability of error is greatly reduced and it is believed that the figures shown are an accurate indication of the cost of the suggested pollution abatement program. Costs of providing lateral sewers or for the extension of sewers to areas now lacking them are not included in the estimates.

The urgency of the individual projects for which cost estimates have been made is far from uniform. Some projects are needed to correct critical pollution conditions while in other cases the need and justification for the expenditure are less outstanding. The basin summaries place stress on the more critical and larger sources of pollution where effects are not confined to local areas. However, cost estimates presented apply not only to the urgent situations but to a complete program of pollution control such as might take place during the course of the next 10 to 20 years. In the special case of a stream highly acid from the effects of mine drainage, expenditure of public funds for acid-reducing measures should precede or at least parallel expenditures for sewage and organic pollution abatement.

Cost estimates are based on average experience from 1928 to 1940. Costs for 1942 would be considerably higher and future costs will probably be subject to further change depending upon fluctuation in construction costs for this type of work.

Throughout the report quantities of organic industrial wastes have been expressed as "sewered population equivalent (biochemical oxygen demand)." Extensive measurements have shown that the average oxygen demand of domestic sewage is 0.168 pound (5-day, 20° C.) per capita per day and this factor has been used to convert industrial waste loads to a readily understandable basis. In the tabulations of sources of pollution (Table 3), the column "Sewered population equivalent (biochemical oxygen demand), untreated" represents the total of the population connected to sewers plus the population equivalent of industrial wastes discharged at each locality. The difference between this column and the adjacent column "Sewered population equivalent (biochemical oxygen demand), discharged" represents the reduction in the pollution load due to treatment in a municipal treatment plant.

Where accurate laboratory results of treatment plant operation were available, these were used to determine the pollution load both before and after treatment. In the absence of such records reductions of 35 percent by primary treatment and 85 percent by secondary treatment were assumed.

No differentiation has been made in the tables, maps, or charts between industrial wastes which are discharged only seasonally and those which are discharged throughout the year. The pollution loading shown represents conditions during normal operations at the height of the season. In the case of the canning industry, this may occur only during a few weeks in the year but these few weeks are often during the late summer when the effects of organic pollution on the oxygen balance of the stream are most serious. On the other hand, the season

for distillery operations in most cases is during the winter months when the effects of oxygen-depleting pollution are less serious.

Nowhere in the report has a quantitative statement been made as to the reduction in the industrial waste pollution load due to treatment, recovery, or other measures at the industrial plant. Such a statement would necessitate a definition of the strength of untreated industrial wastes from each type of industry. This is impracticable since the strength of the wastes depends to a large degree on plant practices which vary widely. For instance, in some meat-packing plants all blood, paunch manure, and offal are recovered and in others these materials are discharged to the plant sewers. Wastes discharged from vegetable canneries have been found to vary by as much as 400 percent due to differences in "housekeeping" methods. Wastes from paper-mills vary depending on the use of save-alls, recirculating systems and other pollution reduction measures. At some plants reduction in pollution is inadvertent and is brought about by the recovery of valuable byproducts or prevention of waste of raw materials. At others expense is incurred which produces nothing but a reduction in pollution discharges. Tabulations of industrial wastes (table 4) show the number of plants that have taken steps of either kind which result in some reduction in the pollution load from the plant.

MAIN OHIO RIVER

CONTENTS

	Page
Contents	205
Syllabus and conclusions	207
Description	209
Presentation of field data	210
Presentation of laboratory data	215
Hydrometric data	228
Discussion	229

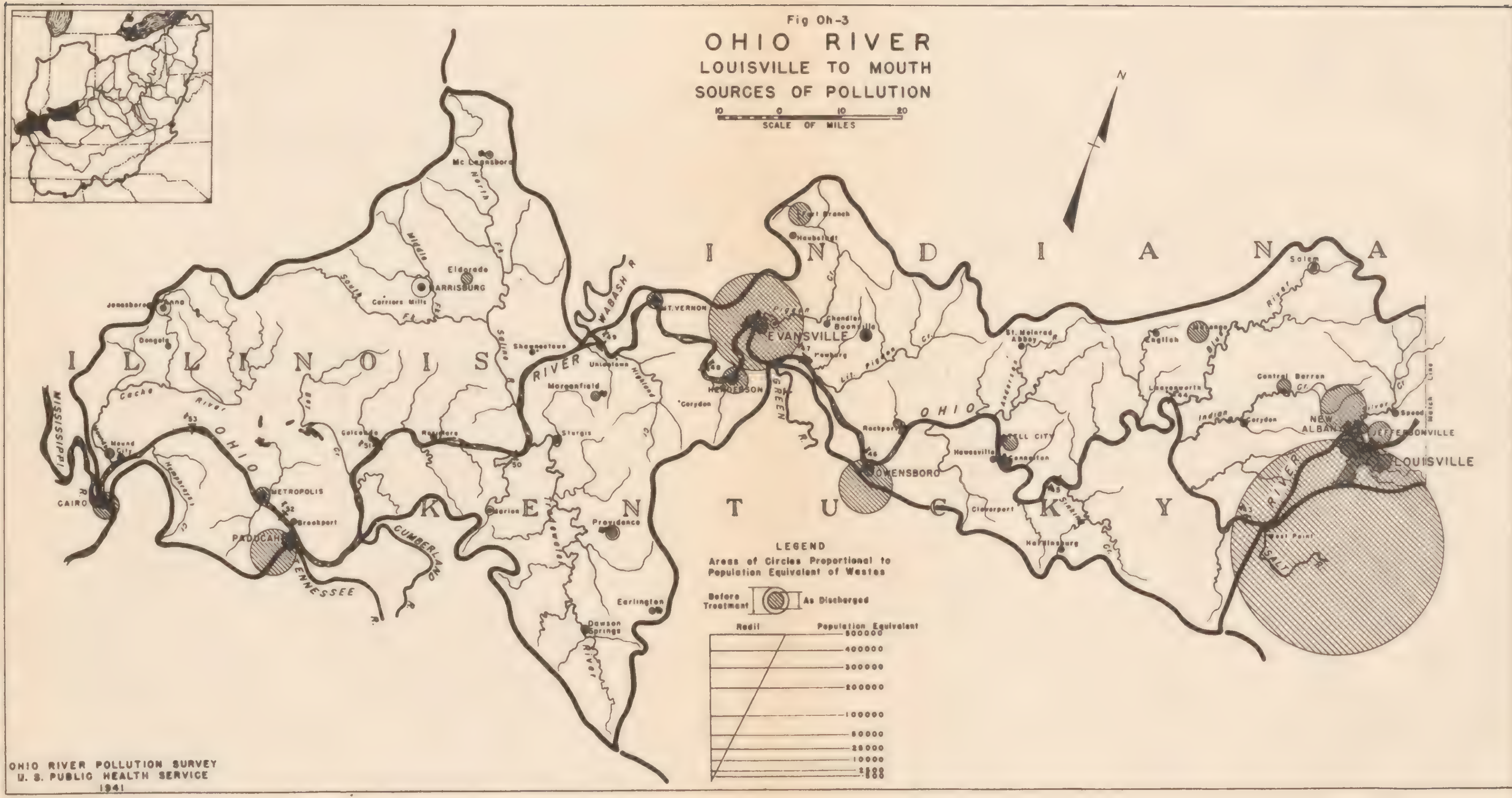
LIST OF TABLES

Oh– 1.—Cost estimates of remedial measures	209
Oh– 2.—Surface water supplies	211
Oh– 3.—Sources of pollution	212
Oh– 4.—Industrial wastes	214
Oh– 5.—Laboratory results—seasonal averages	216
Oh–5a.—Laboratory results, number and percentage of samples within various quality ranges	219
Oh–5b.—Laboratory results, average phenol results	222
Oh– 6.—Monthly mean summer flows	229
Oh– 7.—Summary of laboratory results	237
Oh–7a.—Summary of laboratory results on acid streams	256

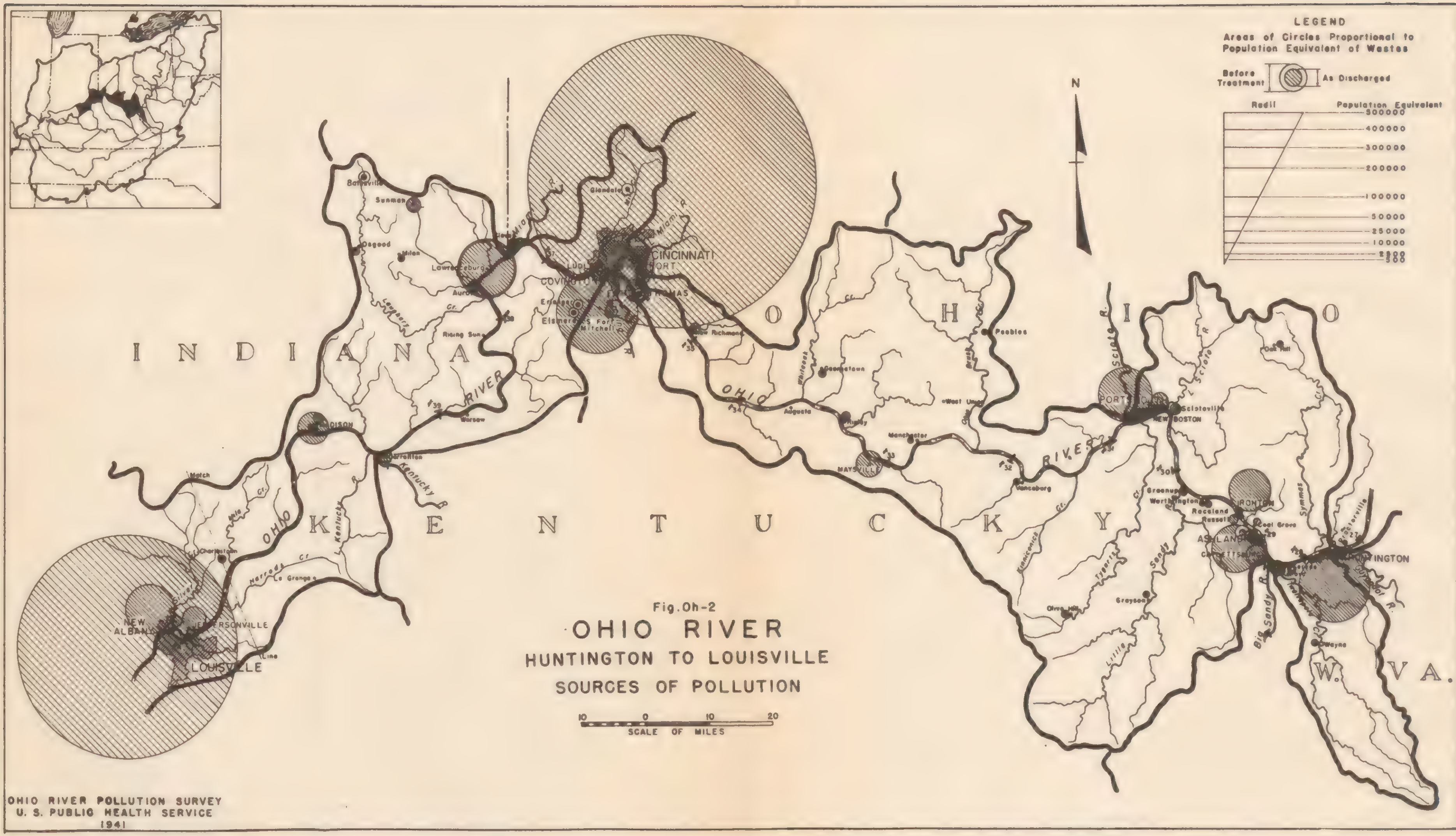
LIST OF FIGURES

Oh– 1.—Map—Sources of pollution (Pittsburgh to Huntington)	207
Oh– 2.—Map—Sources of pollution (Huntington to Louisville)	207
Oh– 3.—Map—Sources of pollution (Louisville to mouth)	207
Oh– 4.—Chart—Sources of pollution and selected laboratory data (Pittsburgh to Huntington)	214
Oh– 5.—Chart—Sources of pollution and selected laboratory data (Huntington to Louisville)	214
Oh– 6.—Chart—Sources of pollution and selected laboratory data (Louisville to mouth)	214
Oh– 7.—Chart—Laboratory results, seasonal averages and distribution of results	218
Oh– 8.—Map—Coliform results (Pittsburgh to Huntington)	222
Oh– 9.—Map—Dissolved oxygen results (Pittsburgh to Huntington)	222
Oh–10.—Map—Biochemical oxygen demand results (Pittsburgh to Huntington)	222
Oh–11.—Chart—Laboratory results at selected stations above Huntington	222
Oh–12.—Map—Coliform results (Huntington to Louisville)	226
Oh–13.—Map—Dissolved oxygen results (Huntington to Louisville)	226
Oh–14.—Map—Biochemical oxygen demand results (Huntington to Louisville)	226
Oh–15.—Chart—Laboratory results at selected stations below Huntington	226
Oh 16.—Map—Coliform results (Louisville to mouth)	228
Oh–17.—Map—Dissolved oxygen results (Louisville to mouth)	228
Oh–18.—Map—Biochemical oxygen demand results (Louisville to mouth)	228
Oh–19.—Chart—Coliform results at Cincinnati Water Works (1926–41)	230

Fig. Oh-3



(Face p. 207) No. 3 GPO-43 O-90035



(Face p. 207) No. 2 GPO-43 O-9035

Fig. Oh-2

Fig. Oh-1

(Face p. 207) No. 1 GPO-43 O-9035

MAIN OHIO RIVER

Syllabus and Conclusions

SYLLABUS

The Ohio River is one of the most intensively used large streams in the United States, supplying water for municipal and industrial use, furnishing a method of sewage and industrial waste disposal, providing transportation facilities and providing many sources of recreation. Pittsburgh, Cincinnati, and Louisville, the largest urban centers on the river, contribute the largest amounts of pollution and there are more than 100 smaller places discharging untreated sewage and wastes. Municipal sewage, acid mine drainage and industrial wastes, such as phenols, which impart objectionable tastes and odors to drinking water are the principal polluting substances.

The interstate character of the Ohio River is in part responsible for the lack of progress made to date in controlling the pollution of the stream. The Ohio River Valley Water Sanitation Compact, which has been approved by the Congress and ratified by four of the State legislatures, pledges the States to joint action for pollution abatement and provides for an interstate administrative agency. This compact should be ratified by the remaining State necessary to make it operative.

This report presents a summary of the information collected and outlines a program of sewage and industrial waste treatment for the main Ohio River. Such a program, coupled with a basin-wide program of mine sealing, low-flow augmentation and similar programs of waste treatment on certain tributary streams would provide an economical and effective method of reducing the pollution of the Ohio River.

CONCLUSIONS

(1) Thirty public water supplies serving 1,663,000 people are taken from the Ohio River proper.

(2) Sewage from about 2,700,000 people and industrial wastes equivalent in oxygen demand to sewage from an additional 2,850,000 people enter the Ohio River and the lower stretches of tributary streams. Only about 1 percent of the sewage is treated prior to discharge.

(3) Laboratory surveys made during 1939–41 showed notable oxygen sags below Cincinnati and Pittsburgh and heavy bacterial pollution below these points and many other cities and at a number of waterworks intakes. The main stream was found to be acid as far downstream as Marietta, Ohio, during a part of the sampling period. It is known to have been acid further downstream on other occasions.

In general, the tributaries are in as good or better sanitary condition at their mouths than the main stream and the effect of tributary inflow is not particularly noticeable.

(4) The major pollution control measures needed on the main river are: (*a*) Reduction of bacterial pollution, particularly at water supply intakes; (*b*) reduction and prevention of the further spread downstream of acidity; (*c*) prevention of taste and odor troubles in public water supplies; and (*d*) correction of objectionable nuisance conditions due to oxygen depletion, discoloration of the stream, floating sewage and other solids and scum.

(5) Efficient primary treatment of sewage plus continuous chlorination should effectively reduce bacterial pollution. Primary treatment of sewage and organic industrial wastes should correct nuisance conditions in the stream, except below Cincinnati and Pittsburgh, when very low flows and high water temperatures prevail. Supplementary measures of low-flow augmentation or chemical treatment would correct these conditions.

(6) Prevention of taste and odor troubles will require special industrial waste treatment at byproduct coke plants, at some chemical plants and at other establishments with similar types of wastes.

(7) Reduction in acidity can be most effectively and economically achieved by a basin-wide program of mine sealing combined with a program of low-flow augmentation.[1] Neutralization of waste industrial acids would aid in reducing acidity.

(8) The following estimates of cost of existing works and of a suggested program of sewage and industrial waste treatment is summarized from table Oh–1. The bulk of the cost for new work is at Pittsburgh, Cincinnati, and Louisville.

Treatment	Capital cost	Annual charges
Existing	$1,080,000	$95,000
Suggested additional	71,030,000	6,710,000

The estimated additional cost over existing charges of a program involving secondary treatment at all sources of pollution on the Ohio River is—

Treatment	Capital cost	Annual charges
Primary, all places	$71,030,000	$6,710,000
Secondary, all places	86,620,000	8,700,000

[1] See section of report on acid mine drainage.

TABLE OH-1.—*Main Ohio River: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	4	16	22,509	$1,080,000	$65,000	$30,000	$95,000
Suggested minimum correction:							
Sewage treatment plants	111	0	2,018,500	27,560,000	1,940,000	1,765,000	3,705,000
Required interceptors				40,350,000	1,890,000		1,890,000
Independent industrial waste correction				3,120,000	410,000	705,000	1,115,000
Total				71,030,000	4,240,000	2,470,000	6,710,000
Comparative cost:							
Primary treatment, all waste				71,030,000	4,240,000	2,470,000	6,710,000
Secondary treatment, all waste				86,620,000	5,335,000	3,365,000	8,700,000
As suggested				71,030,000	4,240,000	2,470,000	6,710,000

NOTE.—Costs shown above include the cost of interceptors and treatment works for city of Pittsburgh and its suburbs along the lower Allegheny and Monongahela Rivers and Chartiers Creek whose wastes would probably be treated at a plant along the Ohio River.

DESCRIPTION

The Ohio River is formed by the junction of the Allegheny and Monongahela Rivers at Pittsburgh, Pa. and flows in a generally southwesterly direction for 981 miles to its confluence with the Mississippi River. It forms the boundary between 5 States: Ohio, Indiana, and Illinois on the north and West Virginia and Kentucky on the south. The 203,900 square miles drained by the Ohio River and its tributaries comprise roughly one-fifteenth of the area of the United States and include parts of 14 States. Most of this area is drained by the 19 major tributaries which are discussed separately. About 23,780 square miles of the watershed drain directly into the Ohio River or through minor tributaries. This section of the report is concerned only with the cities and towns on the Ohio River proper or in metropolitan areas which touch the river.

The three largest cities on the Ohio River are Pittsburgh, Cincinnati, and Louisville. There are 86 incorporated municipalities of more than 2,500 population on the Ohio River and 131 additional smaller incorporated towns. The population of some of the larger cities and of the entire area is shown below:

	Population			
	1910	1920	1930	1940
Principal cities:				
Pittsburgh, Pa	533,905	588,343	669,817	671,659
Cincinnati, Ohio	363,591	401,247	451,160	455,610
Louisville, Ky	223,928	234,891	307,745	319,077
Evansville, Ind	69,647	85,264	102,249	97,062
Huntington, W. Va	31,161	50,177	75,572	78,836
Covington, Ky	53,270	57,121	65,252	62,018
Wheeling, W. Va	41,641	56,208	61,659	61,099
Entire area:				
Urban	1,839,366	2,133,585	2,540,749	2,570,592
Rural [1]	120,993	118,004	115,251	127,217
Total	1,960,359	2,251,587	2,656,000	2,697,809

[1] Includes only incorporated communities of less than 2,500 population on the Ohio River or in metropolitan areas along the stream.

Most of the Ohio River cities are relatively old and their rate of growth during this century has been less rapid than that of other cities in the basin.

Steel production is the outstanding single industry in the Ohio Valley and is predominant in the section above Wheeling. Most of the Ohio River cities below the steel area are more important from the standpoint of commerce and transportation rather than as industrial centers.

Water uses.—Forty-six locks and dams provide slack-water navigation for boats at 9-foot draft for the entire length of the river. A number of additional locks and dams have been replaced by fewer structures of higher lift. In 1940 almost 30,000.000 tons of freight, the bulk of which was coal, were moved by river.

The only hydroelectric development on the Ohio River is at dam No. 41 at Louisville. Relatively small amounts of power might be generated at some of the navigation dams.

The floods of 1936 and 1937 focused national attention on the need for flood protection along the Ohio River. Studies by the United States Engineer Department have indicated the value of reservoirs on tributaries in reducing flood damages along the main stream. Tributary reservoirs are discussed in the basin summaries of this report. A number of possible sites for high dams on the Ohio River have been studied but none have been constructed nor authorized by the Congress.

In spite of many drawbacks the Ohio River is used extensively for recreation. There are numerous boat and yacht clubs and a number of bathing beaches are well patronized. There is considerable sport fishing in some sections of the main stream but much more on minor tributaries. Commercial fishing is practically limited to the lower half of the main stream and is not of great importance.

Presentation of Field Data

Figures Oh–1, Oh–2, and Oh–3 show the location and magnitude of the more important sources of pollution along the upper, middle, and lower thirds of the main Ohio River, respectively. Figures Oh–4, Oh–5, and Oh–6 show similar data and, in addition, the location of water supply intakes and selected laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Thirty public water supplies serving 1,663,000 people are taken from the Ohio River. The three largest supplies (Cincinnati, Louisville, and Evansville) serve a total of more than 1,000,000 people. Table Oh–2 shows data on the Ohio River supplies and on three other surface supplies developed by Ohio River communities from unpolluted sources. The heavy pollution at many of the water intakes necessitates very careful and complete treatment of the water. The supplies subject to the heaviest pollution are those in the upper 100 miles of the river, and those at Ashland, Ironton, Portsmouth, Aurora, New Albany, and Henderson. The Cincinnati, Covington, and Newport supplies, which are taken from the river within 1 mile of each other, and the Lousiville supply are somewhat less seriously polluted. Several million dollars have been spent in recent years to improve water treatment plants because of heavy bacterial loadings and taste and odor difficulties.

TABLE OH-2.—*Main Ohio River: Surface water supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies Below Community Sewer Outfalls					
Cairo	Illinois	Ohio River	4.5	FD	12,000	2.50
Paducah	Kentucky	do	46.9	FD	33,800	2.75
Golconda	Illinois	do	78.5	FD	600	.03
Rosiclare	do	do	90.0	FD	1,800	.08
Morganfield [3]	Kentucky	do	137.0	FD	3,000	.17
Uniontown	do	do	140.7	FD	300	.01
Mount Vernon	Indiana	do	151.9	FD	5,600	.75
Henderson	Kentucky	do	178.0	FD	14,000	3.50
Evansville	Indiana	do	189.4	FD	105,000	11.10
New Albany	do	do	372.6	FD	25,000	2.00
Louisville	Kentucky	do	380.5	FD	350,000	43.70
Aurora	Indiana	do	484.3	FD	1,200	.27
Newport	Kentucky	do	517.3	FD	56,500	4.00
Covington	do	do	518.1	FD	96,800	7.50
Cincinnati	Ohio	do	518.2	LD	560,000	61.30
Maysville	Kentucky	do	572.6	FD	8,000	.33
Portsmouth	Ohio	do	630.1	FD	55,000	3.60
Ironton	do	do	653.8	FD	18,000	1.00
Ashland	Kentucky	do	661.1	FD	45,000	1.81
Huntington	West Virginia	do	676.8	FD	89,000	6.00
Pomeroy	Ohio	do	732.7	FD	6,000	.40
Sistersville	West Virginia	do	843.7	FD	2,800	.65
Bellaire	Ohio	do	887.0	FD	13,800	3.10
Wheeling	West Virginia	do	891.2	FD	70,000	5.00
Steubenville	Ohio	do	915.7	FD	37,600	3.46
Weirton	West Virginia	do	918.5	FD	14,000	1.00
Toronto	Ohio	do	921.9	LD	7,400	.30
East Liverpool	do	do	940.8	FD	23,000	3.50
Midland	Pennsylvania	do	945.1	FD	6,300	.40
Dixmont Hospital	do	do	973.4	FD	1,500	.67
	Other Surface Supplies					
Brooksville	Kentucky	Impounded		FD	500	0.02
New Cumberland	West Virginia	Spring-well-impounded.		D	2,000	.06
Wellsville	Ohio	Impounded		FD	7,700	1.15
Total:						
Below sewer outfalls					1,663,000	170.88
Other					10,200	1.23
Total surface water supplies					1,673,200	172.11

[1] Location of intake in miles above mouth of Ohio River.
[2] F=Coagulated, settled, filtered. L=Lime-soda softened. D=Chlorinated.
[3] Community on minor tributary of Ohio River but water supply from main stream.

Sewerage.—Table Oh–3 shows the sewered population and the total waste load at communities on the main Ohio River. Table Oh–3 and figures Oh–1 to Oh–6 show the size and distribution of these sources of pollution. Sewage from more than 2,000,000 people is discharged at these places, only about 1 percent of which is treated. In addition, sewage from about 640,000 people enters the lower Allegheny and Monongahela in the Pittsburgh area just above the source of the Ohio River, and sewage from about 78,000 people enters the Little Miami River near its mouth, at Cincinnati. The concentrations of population and pollution in the upper 100 miles from Pittsburgh to below Wheeling; in the area from Huntington to Portsmouth; around Cincinnati; Louisville, and Evansville, are notable.

TABLE OH–3.—*Main Ohio River: Sources of pollution, including industrial wastes expressed as sewered population equivalent (biochemical oxygen demand)*[1]

Municipality	State	River miles		Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
		Above mouth	Below Pittsburgh			Untreated	Discharged
Cairo	Illinois	2	979	12,000	None	12,000	12,000
Metropolis	do	37	944	4,200	do	4,200	4,200
Paducah	Kentucky	46	935	29,000	do	39,600	39,600
Mount Vernon	Indiana	152	829	4,200	do	6,000	6,000
Henderson	Kentucky	177	804	11,000	do	14,000	14,000
Evansville	Indiana	189	792	103,300	Secondary[2]	192,300	191,200
Owensboro	Kentucky	222	759	25,600	None	64,400	64,400
Tell City	Indiana	254	727	3,500	do	4,700	4,700
New Albany-Silver Hills.	do	372	609	18,300	do	40,600	40,600
Louisville and suburbs	Kentucky	377	604	304,300	do	906,900	906,900
Jeffersonville-Clarksville.	Indiana	378	603	12,500	do	14,100	14,100
Madison	do	423	558	7,100	do	18,900	18,900
Lawrenceburg	do	488	493	2,500	Secondary	74,000	71,900
Cincinnati and suburbs[3]	Ohio	507	474	512,000	None	1,569,400	1,569,400
Covington and suburbs	Kentucky	510	471	77,800	Secondary[2]	145,900	141,600
Newport and suburbs	do	511	470	60,800	do.[2]	69,400	67,800
Maysville	do	572	409	6,000	None	13,000	13,000
Portsmouth-New Boston.	Ohio	625	356	45,500	Primary[2]	60,000	59,100
Ironton	do	653	328	12,500	None	32,500	32,500
Ashland	Kentucky	658	323	21,000	Secondary[2]	46,100	43,100
Catlettsburg	do	663	318	3,400	None	8,400	8,400
Ceredo-Kenova	West Virginia	666	315	5,100	do	5,100	5,100
Huntington	do	672	309	75,000	do	95,800	95,800
Gallipolis	Ohio	711	270	5,000	do	5,000	5,000
Pomeroy-Middleport	do	729	252	6,000	do	6,000	6,000
Parkersburg	West Virginia	796	185	36,000	do	82,000	82,000
Marietta	Ohio	809	172	13,000	do	13,000	13,000
Moundsville	West Virginia	879	102	16,000	do	16,000	16,000
Bellaire	Ohio	886	95	13,500	do	13,500	13,500
Wheeling and suburbs	West Virginia	890	91	67,300	do	90,100	90,100
Bridgeport-Brookside	Ohio	891	90	5,600	do	5,600	5,600
Martins Ferry	do	892	89	14,700	do	14,700	14,700
Wellsburg	West Virginia	906	75	5,500	do	6,400	6,400
Mingo Junction	Ohio	910	71	5,100	do	5,100	5,100
Follansbee	West Virginia	910	71	4,800	do	36,800	36,800
Steubenville	Ohio	913	68	32,000	do	44,000	44,000
Weirton and suburbs	West Virginia	919	62	16,700	do	36,500	36,500
Toronto	Ohio	921	60	7,000	do	13,700	13,700
Wellsville	do	933	48	7,600	do	7,600	7,600
East Liverpool	do	937	44	21,000	do	23,600	23,600
Midland	Pennsylvania	944	37	6,300	do	34,300	34,300
Beaver	do	954	27	5,600	do	5,600	5,600
Rochester	do	956	25	10,000	do	10,000	10,000
Monaca	do	956	25	8,000	do	8,000	8,000
Freedom	do	957	24	3,200	do	4,900	4,900
Aliquippa	do	961	20	27,000	do	120,000	120,000
Ambridge	do	965	16	25,000	do	25,000	25,000
Sewickley	do	969	12	5,600	do	5,600	5,600
Coraopolis	do	971	10	10,200	do	10,800	10,800
Neville Township	do	973	8	1,500	do	24,400	24,400
Emsworth-Ben Avon	do	975	6	5,200	do	5,200	5,200
Bellevue-Avalon	do	976	5	16,800	do	16,800	16,800

[1] Includes communities on Ohio River and other adjacent communities which probably will discharge waste directly to the river when sewage treatment facilities are provided.
[2] Small portion of sewage treated.
[3] Exclusive of wastes now entering Little Miami River.

TABLE OH–3.—*Main Ohio River: Sources of pollution, including industrial wastes expressed as sewered population equivalent (biochemical oxygen demand)*—Con.

Municipality	State	River miles		Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
		Above mouth	Below Pittsburgh			Untreated	Discharged
Pittsburgh and suburbs[4 5]	Pennsylvania	980	1	261,700	None	278,600	278,600
65 smaller sources				72,700	(6)	78,100	75,300
Total:							
Illinois				18,500		18,700	18,400
Indiana				157,400		357,000	353,500
Kentucky				545,700		1,316,300	1,307,000
Ohio				719,200		1,833,700	1,832,200
Pennsylvania				397,300		560,400	559,200
West Virginia				254,100		398,100	398,100
Total entire stream				2,092,200		4,484,200	4,468,400

4 Pollution loads from Pittsburgh and suburbs are distributed to Allegheny and Monongahela Basins and Main Ohio River as follows:

Municipality	State	River miles		Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
		Above mouth	Below Pittsburgh			Untreated	Discharged
Pittsburgh and suburbs:							
Allegheny River.	Pennsylvania	0–8		320,500	None	597,200	597,200
Monongahela River.	do	0–10		319,500	do	458,500	458,500
Ohio River	do		0–4	261,700	do	278,600	278,600
Total				901,700		1,334,300	1,334,300

5 Exclusive of wastes now entering Allegheny and Monongahela Rivers.
6 Secondary treatment at 3 places, primary at 3, none at others.

Industrial wastes.—The oxygen demand of industrial wastes entering the Ohio River is equivalent to that of sewage of about 2,400,000 people. Industrial wastes with an additional population equivalent of about 415,000 enter the lower Allegheny and Monongahela at Pittsburgh, and the Little Miami at Cincinnati receives industrial wastes with a population equivalent of about 50,000. Table Oh–4 summarizes the industrial waste load by type of industry and method of disposal with the exception of the industries at Cincinnati which were not surveyed individually. Distilleries, byproduct coke plants, meat-processing plants, and breweries are the largest sources of organic industrial wastes outside of Cincinnati. At Cincinnati, soap, fertilizer, glue, paper, and meat plants, tanneries, and breweries are the principal sources of industrial wastes.

More than 80 percent of the organic industrial waste load is discharged from the Cincinnati area and downstream, the largest concentrations being at Cincinnati and Louisville (see table Oh–3). The

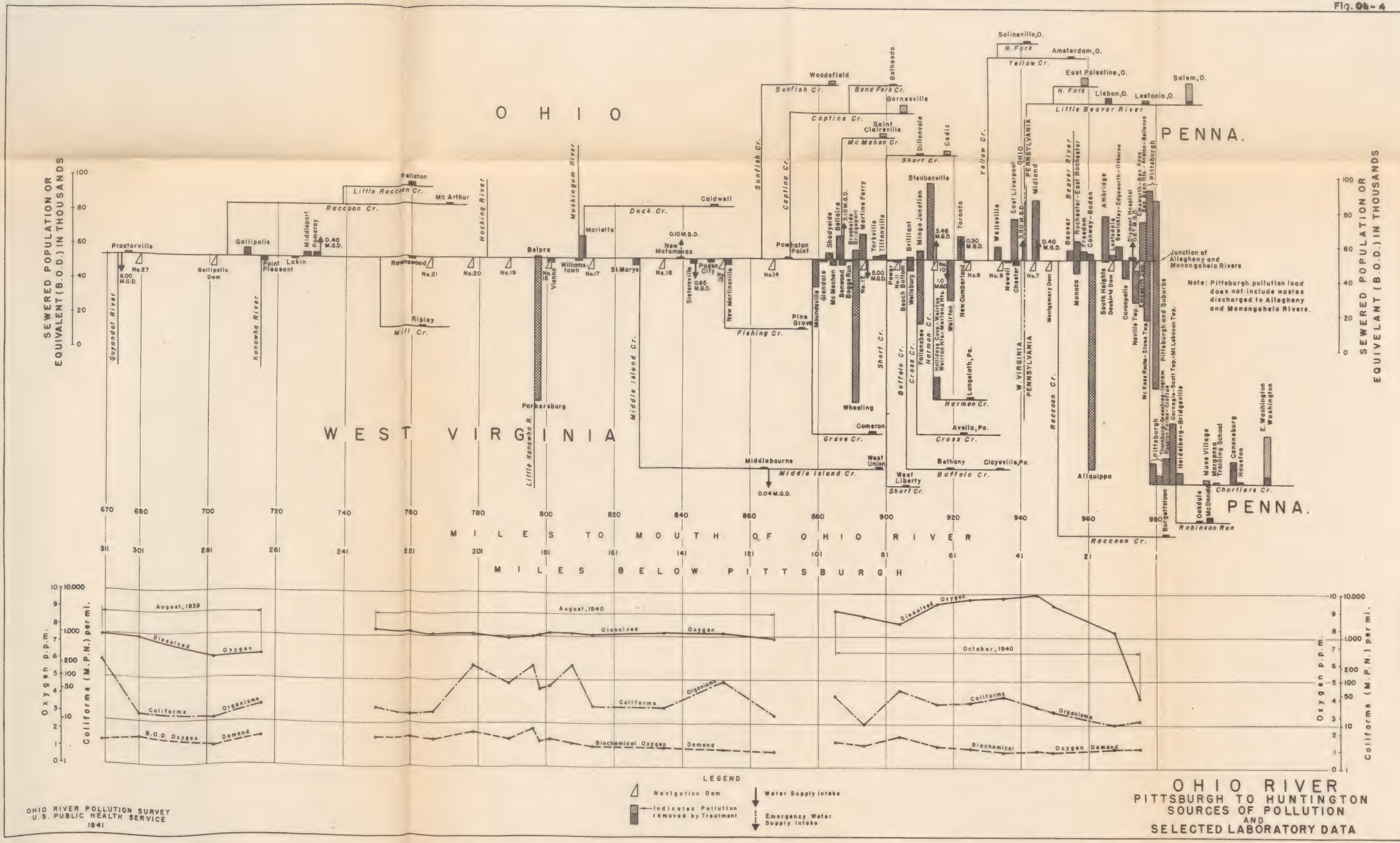
largest sources of organic industrial wastes along the Ohio above Cincinnati are the byproduct coke plants associated with blast furnaces in the steel-producing area. All of these plants are located above the Scioto River.

The principal industry along the upper river is steel production and, although large amounts of water are used in the steel mills, deleterious wastes are practically limited to spent acids used in pickling. A total of about 120,000 pounds of acid per day are discharged from the 62 steel plants along the river and almost all of this enters the upper 100 miles of the stream which is acid for a considerable part of the time, principally because of mine drainage.

TABLE OH–4.—*Main Ohio River: Summary of industrial wastes discharged to the stream*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Canning	14	10	4	2	42,500
Meat	52	32	20	32	118,200
Milk	41	38	3	2	16,900
Brewing	13	13		13	103,200
Distilling	24	14	10	11	588,700
Tanning	3	2	1		21,600
Textile	10	8	2	3	44,400
Paper	6	2	4	3	19,900
Chemical	10	4	6	7	67,300
Oil refining	12	2	10	11	46,100
Byproduct coke	8	1	7	7	234,000
Steel	62	3	59	15	
Miscellaneous	59	28	31	19	31,800
Subtotal	314	157	157	125	1,334,600
Industrial wastes to Cincinnati sewers [1]					1,057,400
Total industrial waste load, Ohio River					2,392,000

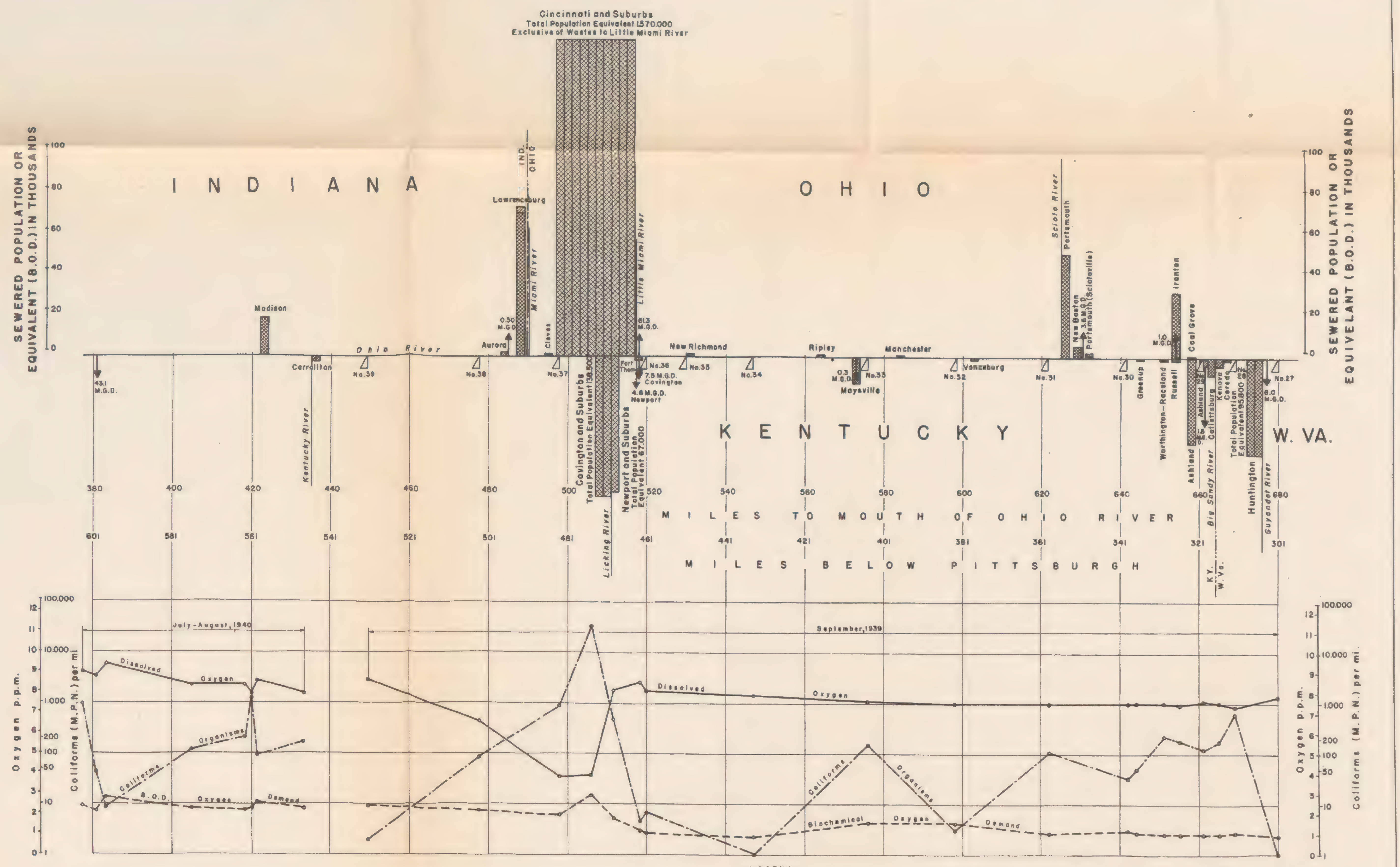
[1] Industries not surveyed individually. Population equivalent based on comprehensive sewer gaging and sampling program of city.



OHIO RIVER
PITTSBURGH TO HUNTINGTON
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

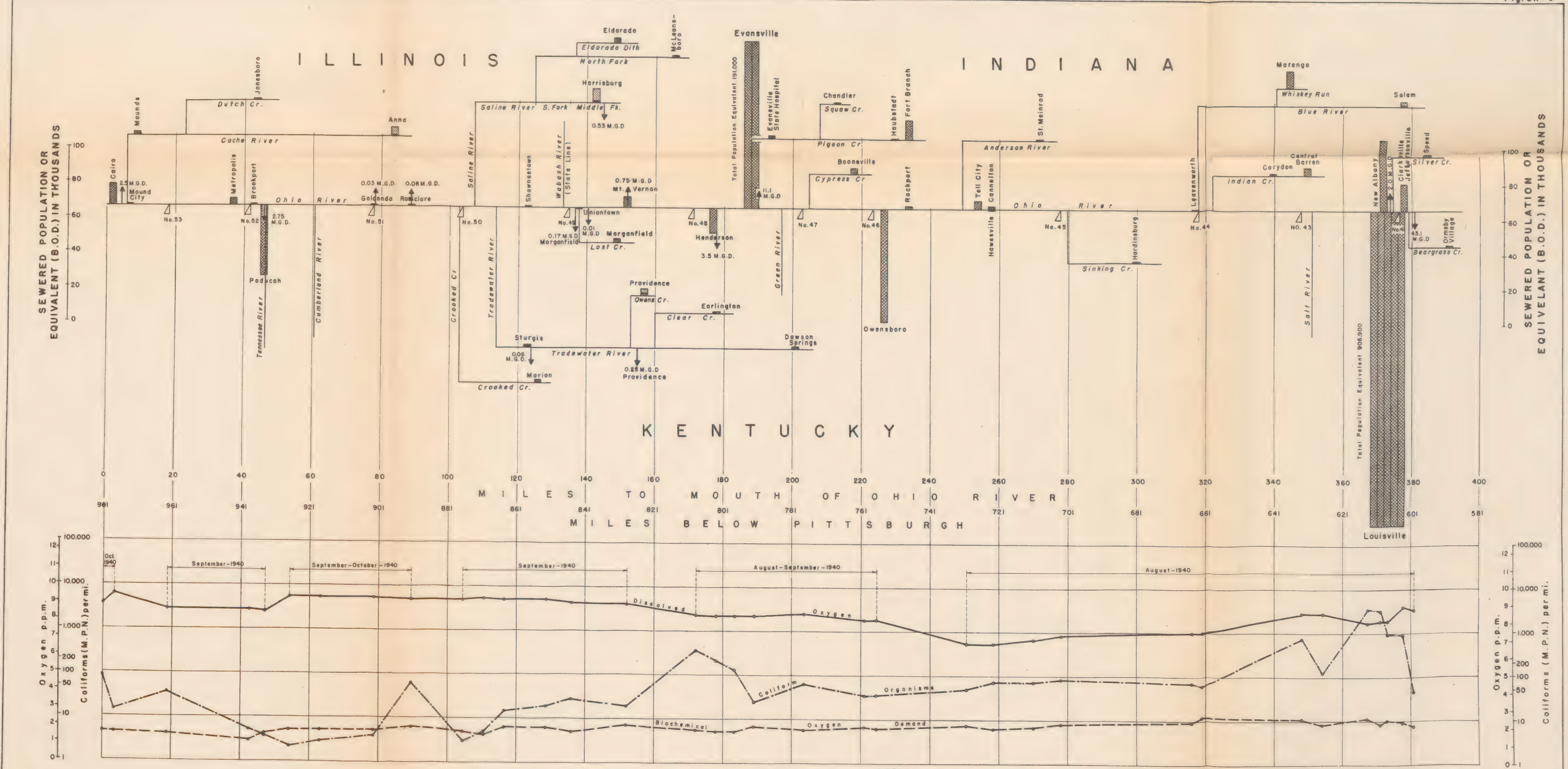
Fig. Oh-5



OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

OHIO RIVER
HUNTINGTON TO LOUISVILLE
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA

Fig. Oh-6



LEGEND

Navigation Dam

Water Supply Intake

Indicates Pollution removed by Treatment

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

OHIO RIVER
LOUISVILLE TO MOUTH SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

GPO-43 O-90035

Presentation of Laboratory Data

Laboratory data on the main Ohio River are summarized in tables as follows:

Table Oh–5.—Seasonal average results.
Table Oh–5A.—Frequency in designated ranges.
Table Oh–5B.—Average phenol results.
Table Oh–7.—Monthly average results.
Table Oh–7A.—Acid stream results.

Stream samples were collected from February 1939 to March 1941 and examined at the Cincinnati laboratory, the laboratory boat *Kiski*, and mobile laboratory units. The following schedule shows the periods during which samples were collected on the various stream sections and the laboratories at which the samples were examined:

Pittsburgh to dam 13: October–December 1940 (*Kiski* laboratory); May 1940–March 1941 (mobile laboratories).
Dam 14–dam 23: May–September 1940 (*Kiski* laboratory); January–March 1941 (*Kiski* laboratory).
Point Pleasant–dam 32: June 1939–April 1940 (*Kiski* laboratory); April 1940 (mobile laboratories).
Dam 33–dam 39: February 1939–April 1940 (*Cincinnati* laboratory).
Dam 39–mouth: June 1940–March 1941 (mobile laboratories).

PITTSBURGH TO HUNTINGTON

The Ohio River was at low or moderate stages during the entire period from May 1940 to March 1941. Consequently good high-water observations are not available for the section above the mouth of the Kanawha River at Point Pleasant.

Figures Oh–8, Oh–9, and Oh–10 show the most unfavorable monthly average coliform, dissolved oxygen, and biochemical oxygen demand results respectively, as found by this survey.

Figure Oh–7 shows group distribution and seasonal averages of coliform, oxygen demand, and dissolved oxygen results at each of the Ohio River stations from Pittsburgh to the mouth for the entire period of the survey. Table Oh–5 shows seasonal averages of laboratory results at these same stations. In figure Oh–11 variations in coliform, dissolved oxygen, and oxygen demand results during the sampling period are shown for four sampling stations between Pittsburgh and Huntington. The generally high dissolved oxygen and low oxygen demands in the river as well as the more sensitive changes in the coliform content throughout the survey period are shown by these charts. A marked dissolved oxygen depression is noted at Emsworth Dam in October.

TABLE OH-5.—*Main Ohio River laboratory results—seasonal averages*

Station	Miles below Pittsburgh	Summer low-water results: Date	Summer: Temperature ° C.	Summer: Oxygen results, parts per million: Dissolved oxygen	Summer: Oxygen results: Biochemical oxygen demand	Summer: Coliforms, most probable number per milliliter	Winter low-water results: Date	Winter low: Temperature ° C.	Winter low: Oxygen results, parts per million: Dissolved oxygen	Winter low: Oxygen results: Biochemical oxygen demand	Winter low: Coliforms, most probable number per milliliter	Winter high-water results: Date	Winter high: Temperature ° C.	Winter high: Oxygen results, parts per million: Dissolved oxygen	Winter high: Oxygen results: Biochemical oxygen demand	Winter high: Coliforms, most probable number per milliliter
Emsworth Dam	6.0						November and December 1940.	6.7	12.5	1.8	157					
Dashield Dam	13.5						do	6.0	12.2	1.8	99					
Montgomery Dam	31.7						do	6.0	12.4	1.8	80					
Dam No. 7	36.5						do	6.0	13.2	1.8	75					
Dam No. 8	46.4						do	6.3	12.8	1.4	71					
Dam No. 9	56.1						do	6.2	12.6	1.8	66					
Dam No. 10	66.0						do	6.8	12.5	1.8	63					
Dam No. 11	77.0						do	6.8	12.4	2.1	51					
Dam No. 12	87.5						do	7.1	12.2	2.0	58					
Dam No. 13	96.0						do	6.8	12.1	2.1	133					
Dam No. 14	114.0	July-September 1940.	23.7	8.0	.8	24	January and March 1941.	2.8	13.4	2.0	24					
Dam No. 15	129.0	do	23.9	8.2	.8	68	do	2.6	13.7	1.8	19					
Dam No. 16	146.5	do	23.8	8.3	1.0	18	do	2.9	13.7	1.8	14					
Dam No. 17	167.5	do	24.6	8.2	1.1	35	do	1.9	13.6	1.9	14					
Argand Landing	173.5	do	24.8	8.3	1.3	64	do	2.0	13.6	1.7	27					
Dam No. 18	180.0	do	24.6	8.2	1.5	47	do	2.0	13.6	1.6	22					
Congress Landing	183.0	do	24.8	8.0	1.9	55	do	2.0	13.6	1.6	18					
Rapps Run Light	185.0	do	24.8	7.9	2.0	111	do	1.9	13.6	1.8	39					
Dam No. 19	192.0	do	24.7	8.0	1.7	66	do	3.0	13.4	1.8	24					
Dam No. 20	202.5	do	24.2	8.1	1.8	96	do	2.4	13.4	2.0	35					
Dam No. 21	214.5	do	23.9	8.1	1.5	30	do	2.6	13.2	3.0	30					
Dam No. 22	221.0	do	23.4	8.1	1.5	21	do	3.0	13.4	1.9	30					
Dam No. 23	231.5	do	24.2	8.2	1.6	20	do	3.1	13.4	2.0	24					
Point Pleasant	265.0	do	24.9	6.6	1.2	18	November and December 1939; January 1940.	5.1	12.3	1.0	10	February-April 1940.	5.3	12.2	2.3	30

Gallipolis Dam	279.0	July-September 1939.	24.8	6.3	1.0	12	do	6.6	11.2	1.0	10	do	4.7	12.2	2.0	22
Dam No. 27	301.0	do	25.9	7.4	1.3	15	do	5.7	12.5	1.3	12	do	4.9	12.1	2.8	33
Dam No. 28	312.0	do	25.8	7.3	1.4	337	do	5.3	12.5	1.1	15	do	5.0	12.3	2.0	44
Norfolk & Western R. R. bridge.	316.0	do	25.6	7.6	1.0	190	do	5.2	12.6	1.0	40	do	4.6	12.1	1.9	41
Dam No. 29	320.0	do	25.7	7.6	1.1	216	do	5.3	12.6	1.1	47	do	4.6	12.1	2.0	38
White Oak Creek	326.0	do	25.7	7.4	1.0	229	do	5.6	12.7	1.2	62	do	4.7	12.1	2.1	50
Hanging Rock Light	330.0	do	25.6	7.4	1.0	223	do	5.5	12.6	1.0	57	do	4.6	12.1	1.9	32
Coal Branch Light	337.0	do	25.5	7.3	1.2	148	do	5.2	12.5	1.0	59	do	4.6	12.2	1.7	42
Dam No. 30	339.0	do	26.0	7.4	1.2	117	do	5.5	12.4	1.3	49	do	4.9	12.0	2.0	40
Dam No. 31	359.0	do	24.8	7.3	1.3	87	do	4.7	12.3	1.5	35	do	4.7	11.9	2.2	52
Dam No. 32	383.0	do	25.7	7.3	1.4	32	do	5.4	12.1	1.5	28	do	5.2	11.7	2.4	69
Dam No. 33	405.0	do	25.6	7.5	1.8	80	do	5.4	12.3	1.2	17	do	5.0	12.0	2.2	53
Dam No. 34	434.0	do	25.1	7.3	1.4	73	do	4.6	12.2	.9	22	do	4.5	11.7	2.2	56
Dam No. 35	451.0	do					do					do				
Dam No. 36	461.0	do	24.4	7.5	1.4	48	November and December 1939.	7.0	11.8	1.2	31	do	4.5	11.6	2.1	70
Stillwater Landing	462.8	do	25.9	7.8	1.5	162	do	7.8	12.2	1.4	17	April 1940	8.5	10.3	2.1	100
Louisville & Nashville R. R. bridge.	469.5	do	25.7	7.5	1.7	437	do	7.8	12.1	1.8	236	do	8.7	10.4	1.8	56
Riverside	475.0	do	25.7	5.6	2.5	13,337	do	7.7	11.5	3.5	2,895	do	8.7	10.4	2.0	402
Dam No. 37	483.0	do	26.0	5.2	2.1	2,901	do	7.2	11.0	3.0	1,840	February and April 1940.	5.9	11.5	3.2	111
Dam No. 38	503.0	do	25.3	6.3	2.1	481	do	6.8	10.8	2.5	1,670	do	5.4	11.4	3.0	121
Dam No. 39	531.7	do	25.9	7.0	2.0	103	do	7.4	11.0	2.3	540	do	6.4	10.8	2.4	187
Notch Lick Light	547.8	July 1940	26.6	7.9	2.2	186	January 1941.	3.9	12.7	3.5	87					
Crooked Creek (upper light)	559.5	do	29.0	8.5	2.6	94	do									
Clifty Creek (lower light).	561.0	do	28.1	7.9	2.2	1,260	do	3.4	12.5	3.4	199					
Lower Hanover Landing.	562.6	do	29.0	8.3	2.1	218	do	3.3	12.5	3.5	60					
Jobson Landing Light	576.1	do	27.3	8.3	2.2	113	do	3.1	12.6	3.2	108					
Louisville waterworks	600.0	do	29.0	8.8	2.2	44	do	2.6	12.6	1.6	143					
New Albany waterworks.	608.5	August 1940.	28.4	8.2	2.6	997	February 1941.	2.0	13.1	1.7	142					
Falling Run Light	610.0	do	28.8	8.2	2.3	3,220	do	2.1	13.0	1.8	258					
Hughes Bar (upper light).	614.0	do	28.3	8.1	2.6	3,480	do	2.1	13.1	4.2	87					
Steve Green Landing Light.	627.0	do	28.8	8.6	2.3	105	do	1.2	12.9	2.5	141					
Dam No. 43	633.2	do	28.6	8.6	2.6	740	do	1.6	13.0	3.2	153					
Rock Haven (upper light).	637.0	do					do	1.6	12.8	2.4	195					
Falling Spring (lower light).	639.0	do					do	1.6	12.9	1.6	246					

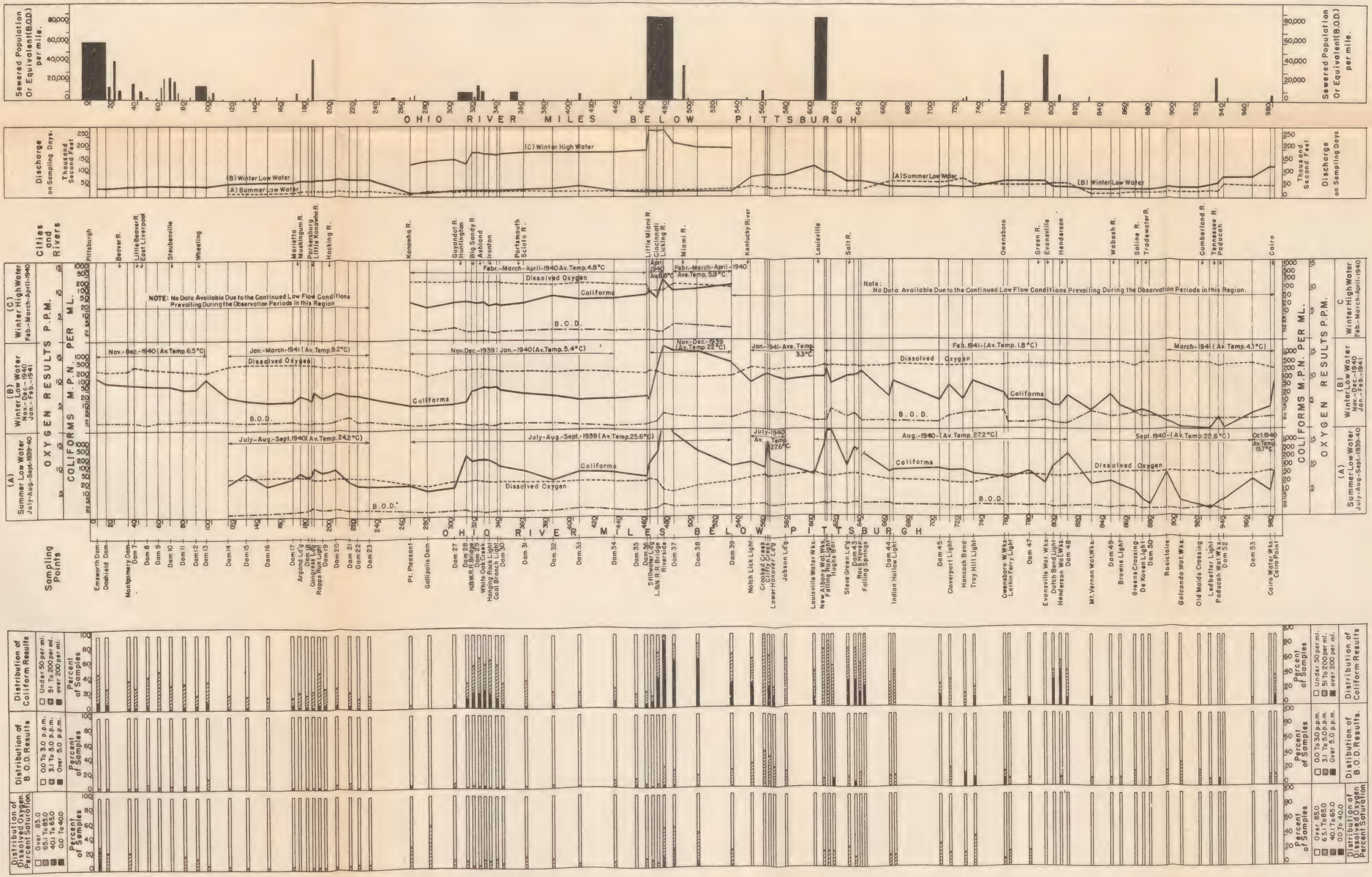
TABLE OH-5.—*Main Ohio River laboratory results—seasonal averages*—Continued

Station	Miles below Pittsburgh	Summer low-water results					Winter low-water results					Winter high-water results				
		Date	Temperature ° C.	Oxygen results, parts per million		Coliforms, most probable number per milliliter	Date	Temperature ° C.	Oxygen results, parts per million		Coliforms, most probable number per milliliter	Date	Temperature ° C.	Oxygen results, parts per million		Coliforms, most probable number per milliliter
				Dissolved oxygen	Biochemical oxygen demand				Dissolved oxygen	Biochemical oxygen demand				Dissolved oxygen	Biochemical oxygen demand	
Dam No. 44	662.0	August 1940	26.5	7.5	2.7	63	February 1941.	3.9	13.0	1.8	23					
Indian Hollow Light	665.0	do	27.2	7.5	2.4	73	do	3.7	13.3	1.7	96					
Dam No. 45	703.0	do	27.2	7.3	2.3	90	do	3.7	13.1	1.5	16					
Cloverport Light	711.0	do	26.8	7.0	2.1	78	do	2.1	13.1	2.6	65					
Hancock Bend Light	722.7	do	27.0	6.8	2.0	78	do	2.1	13.1	3.0	14					
Troy Hill Light	730.6	do	27.8	6.8	2.2	51	do	2.2	13.1	3.3	96					
Owensboro waterworks	756.5	do	25.7	8.1	2.0	37	do	1.0	13.1	3.6	29					
Larkin Ferry Light	760.0	do	25.7	8.1	2.1	35	do	.5	13.4	1.1	16					
Dam No. 47	777.7	do	25.8	8.4	1.9	66	do	1.1	13.4	1.2	17					
Evansville waterworks	791.0	do	25.9	8.3	2.1	22	do	.8	13.4	1.7	16					
Dutch Bend Light	797.7	do	26.5	8.3	1.7	106	do	.8	13.4	1.3	9					
Henderson waterworks	803.0	do	26.5	8.2	1.7	199	do	.8	13.4	1.1	9					
Dam No. 48	809.0	do	26.4	8.3	1.9	356	do	.8	13.3	1.1	24					
Mount Vernon waterworks.	829.1	September 1940.	23.2	9.0	2.1	19	do	2.3	13.6	3.7	6					
Dam No. 49	845.0	do	24.0	9.1	1.7	29	do	2.1	13.6	2.7	28					
Browns Island Light	852.0	do	24.1	9.2	2.0	19	do	2.0	13.9	2.8	8					
Greens Crossing (upper light).	865.0	do	23.3	9.2	2.0	11.	do	1.8	13.1	3.4	5					
DeKoven Light	870.7	do	23.3	9.3	1.5	5	do	1.8	13.9	2.7	6					
Dam No 50	876.8	do	23.1	9.2	1.6	3	do	1.8	13.8	2.8	5					
Rosiclaire	891.6	do	21.2	9.2	2.0	62	do	2.8	13.8	2.1	2					
Golconda waterworks	902.5	do	21.5	9.3	1.8	4	March 1941	2.7	13.8	2.7	1					
Old Maids Crossing Light.	918.0	do	21.1	9.3	1.8	3	do	3.1	13.8	2.2	1					
Ledbetter Light	927.3	do	21.7	9.3	1.8	2	do	3.2	13.7	2.1	1					
Paducah waterworks	934.3	do	22.4	8.5	1.6	4	do	6.3	13.1	2.1	3					
Dam No 52	938.9	do	22.6	8.6	1.2	5	do	4.8	13.4	2.1	1					
Dam No. 53	962.6	do	22.6	8.7	1.6	37	do	4.6	13.6	2.0	4					
Cairo waterworks	978.0	October 1940	19.8	9.4	1.7	11	do	5.0	12.8	2.4	7					
Cairo Point	981.0	do	19.6	8.9	1.7	89	do	4.2	12.6	2.4	102					

Fig. Oh-7

OHIO RIVER LABORATORY RESULTS

SEASONAL AVERAGES AND DISTRIBUTION OF RESULTS



OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941.

TABLE OH–5A.—*Number and percentage of samples at points on main Ohio River showing coliform numbers, dissolved oxygen, and 5-day biochemical oxygen demand within designated ranges*

Station	Miles from Pittsburgh	Coliform organisms per milliliter							Dissolved oxygen, percent saturation									5-day biochemical oxygen demand, parts per million						
		Number samples	0-50		51–200		Over 200		Number samples	Over 85		65.1–85		40.1–65		0–40		Number samples	0-3		3.1–5		Over 5	
			Number	Percent	Number	Percent	Number	Percent		Number	Percent	Number	Percent	Number	Percent	Number	Percent		Number	Percent	Number	Percent	Number	Percent
Emsworth Dam	6.0	39	19	49	16	41	4	10	39	26	67	2	5	5	13	6	15	39	38	97	1	3	0	0
Dashield Dam	13.5	39	27	69	9	23	3	8	39	29	74	10	26	0	0	0	0	39	38	97	1	3	0	0
Montgomery Dam	31.7	39	23	59	15	38	1	3	39	29	74	10	26	0	0	0	0	39	38	97	1	3	0	0
Dam No. 7	36.5	32	22	69	9	28	1	3	32	32	100	0	0	0	0	0	0	32	31	97	1	3	0	0
Dam No. 8	46.4	37	20	54	15	41	2	5	37	37	100	0	0	0	0	0	0	37	34	92	3	8	0	0
Dam No. 9	56.1	32	15	47	17	53	0	0	32	32	100	0	0	0	0	0	0	32	30	94	2	6	0	0
Dam No. 10	66.0	41	27	66	13	32	1	2	41	41	100	0	0	0	0	0	0	41	38	93	3	7	0	0
Dam No. 11	77.0	41	26	63	13	32	2	5	41	33	80	8	20	0	0	0	0	41	38	93	2	5	1	2
Dam No. 12	87.5	35	28	80	5	14	2	6	35	29	83	6	17	0	0	0	0	35	33	94	2	6	0	0
Dam No. 13	96.0	41	21	51	16	39	4	10	41	38	93	3	7	0	0	0	0	40	34	85	6	15	0	0
Dam No. 14	114.0	65	52	80	12	18	1	2	65	62	95	3	5	0	0	0	0	65	64	98	1	2	0	0
Dam No. 15	129.0	65	53	82	10	15	2	3	65	63	97	2	3	0	0	0	0	65	65	100	0	0	0	0
Dam No. 16	146.5	65	54	83	11	17	0	0	65	63	97	2	3	0	0	0	0	65	65	100	0	0	0	0
Dam No. 17	167.5	64	54	84	7	11	3	5	64	61	95	3	5	0	0	0	0	64	63	98	1	2	0	0
Argand Landing	173.5	64	49	77	13	20	2	3	64	64	100	0	0	0	0	0	0	64	64	100	0	0	0	0
Dam No. 18	180.0	63	51	81	10	16	2	3	63	63	100	0	0	0	0	0	0	63	62	98	1	2	0	0
Congress Landing	183.0	59	44	75	13	22	2	3	59	57	97	2	3	0	0	0	0	59	58	98	1	2	0	0
Rapps Run Light	185.0	59	29	49	26	44	4	7	59	57	97	2	3	0	0	0	0	59	57	97	2	3	0	0
Dam No. 19	192.0	65	46	69	15	25	4	6	64	62	96	2	4	0	0	0	0	65	64	98	0	0	1	2
Dam No. 20	202.5	65	45	69	16	25	4	6	64	62	97	2	3	0	0	0	0	65	61	94	4	6	0	0
Dam No. 21	214.5	66	50	76	12	18	4	6	65	61	94	4	6	0	0	0	0	66	60	91	5	8	1	1
Dam No. 22	221.0	65	54	83	10	15	1	2	64	59	92	5	8	0	0	0	0	65	64	98	1	2	0	0
Dam No. 23	231.5	63	51	81	11	17	1	2	62	57	92	5	8	0	0	0	0	63	62	98	1	2	0	0
Point Pleasant	265.0	54	51	94	3	6	0	0	54	37	69	17	31	0	0	0	0	54	52	96	1	2	1	2
Gallipolis Dam	279.0	63	63	100	0	0	0	0	62	26	42	36	58	0	0	0	0	63	63	100	0	0	0	0
Dam No. 27	301.0	68	65	96	3	4	0	0	68	60	88	8	12	0	0	0	0	68	64	94	3	4	1	2
Dam No. 28	312.0	69	44	64	15	22	10	14	70	63	90	7	10	0	0	0	0	70	69	99	1	1	0	0
Norfolk & Western Railroad bridge	316.0	96	40	42	35	36	21	22	97	95	98	2	2	0	0	0	0	97	94	97	3	3	0	0
Dam No. 29	320.0	97	30	31	47	48	20	21	97	94	97	3	3	0	0	0	0	97	95	98	2	2	0	0
White Oak Creek	326.0	94	38	40	32	34	24	26	94	83	88	11	12	0	0	0	0	94	92	98	1	1	1	1
Hanging Rock Light	330.0	94	31	33	44	47	19	20	94	84	89	10	11	0	0	0	0	94	93	99	0	0	1	1
Coal Branch Light	337.0	91	36	40	42	46	13	14	91	79	87	12	13	0	0	0	0	91	90	99	1	1	0	0
Dam No. 30	339.0	66	42	64	20	30	4	6	68	63	93	5	7	0	0	0	0	68	66	97	2	3	0	0

TABLE OH-5A.—*Number and percentage of samples at points on main Ohio River showing coliform numbers, dissolved oxygen, and 5-day biochemical oxygen demand within designated ranges*—Continued

Station	Miles from Pittsburgh	Coliform organisms per milliliter							Dissolved oxygen, percent saturation									5-day biochemical oxygen demand, parts per million						
		Number samples	0–50		51–200		Over 200		Number samples	Over 85		65.1–85		40.1–65		0–40		Number samples	0–3		3.1–5		Over 5	
			Number	Percent	Number	Percent	Number	Percent		Number	Percent	Number	Percent	Number	Percent	Number	Percent		Number	Percent	Number	Percent	Number	Percent
Dam No. 31	359.0	71	43	61	26	36	2	3	71	59	83	12	17	0	0	0	0	71	68	96	3	4	0	0
Dam No. 32	383.0	67	51	76	13	20	3	4	67	58	87	9	13	0	0	0	0	65	61	94	4	6	0	0
Dam No. 33	405.0	43	33	77	9	21	1	2	43	41	95	2	5	0	0	0	0	43	42	98	0	0	1	2
Dam No. 34	434.0	73	53	72	13	18	7	10	72	66	92	6	8	0	0	0	0	73	65	89	7	10	1	1
Dam No. 35	451.0	38	29	76	8	21	1	3	38	38	100	0	0	0	0	0	0	38	33	87	4	10	1	3
Dam No. 36	461.0	132	102	77	22	17	8	6	129	112	87	17	13	0	0	0	0	132	126	95	5	4	1	1
Stillwater Landing	462.8	78	65	83	7	9	6	8	77	69	90	8	10	0	0	0	0	77	76	99	1	1	0	0
Louisville & Nashville Railroad bridge	469.5	155	36	23	54	35	65	42	154	135	88	19	12	0	0	0	0	156	148	95	8	5	0	0
Riverside	475.0	72	1	1	5	7	66	92	73	33	45	30	41	5	7	5	7	72	50	69	20	28	2	3
Dam No. 37	483.0	147	19	13	31	21	97	66	135	80	59	34	25	15	11	6	5	147	110	75	32	22	5	3
Dam No. 38	503.0	138	16	12	30	21	92	67	136	71	52	53	39	11	8	1	1	139	116	83	22	16	1	1
Dam No. 39	531.7	88	25	28	34	39	29	33	88	68	77	19	22	1	1	0	0	88	66	75	21	24	1	1
Notch Lick Light	547.8	9	3	33	3	34	3	33	9	9	100	0	0	0	0	0	0	9	6	67	3	33	0	0
Crooked Creek (Upper Light)	559.5	2	0	0	2	100	0	0	2	2	100	0	0	0	0	0	0	2	1	50	1	50	0	0
Clifty Creek (Lower Light)	561.0	7	2	29	3	43	2	28	7	7	100	0	0	0	0	0	0	7	4	57	3	43	0	0
Lower Hanover Landing	562.6	7	5	71	1	15	1	14	7	7	100	0	0	0	0	0	0	7	5	71	2	29	0	0
Jobson Landing Light	576.1	9	3	33	6	67	0	0	9	9	100	0	0	0	0	0	0	9	7	78	2	22	0	0
Louisville waterworks	600.0	8	4	50	3	38	1	12	8	8	100	0	0	0	0	0	0	8	8	100	0	0	0	0
New Albany waterworks	608.5	9	0	0	2	22	7	78	9	7	78	2	22	0	0	0	0	9	8	89	1	11	0	0
Falling Run Light	610.0	9	0	0	1	11	8	89	9	7	78	2	22	0	0	0	0	9	9	100	0	0	0	0
Hughes Bar (Upper Light)	614.0	9	0	0	4	44	5	56	9	7	78	2	22	0	0	0	0	9	8	89	0	0	1	11
Kosmosdale [1]	627.0	14	3	21	6	43	5	36	14	10	71	4	29	0	0	0	0	14	12	86	2	14	0	0
Dam No. 43	633.2	14	3	21	6	43	5	36	14	12	86	2	14	0	0	0	0	14	13	93	0	0	1	7
Rock Haven (Upper Light)	637.0	10	2	20	6	60	2	20	2	2	100	0	0	0	0	0	0	5	4	80	1	20	0	0
Falling Spring (Lower Light)	639.0	10	0	0	7	70	3	30	2	2	100	0	0	0	0	0	0	5	5	100	0	0	0	0
Dam No. 44	662.0	6	4	67	2	33	0	0	6	5	83	1	17	0	0	0	0	6	5	83	1	17	0	0
Indian Hollow Light	665.0	6	3	50	3	50	0	0	6	5	83	1	17	0	0	0	0	6	5	83	1	17	0	0
Dam No. 45	703.0	6	4	67	1	17	1	16	6	4	67	2	33	0	0	0	0	6	6	100	0	0	0	0
Cloverport Light	711.0	5	3	60	2	4	0	0	5	4	80	1	20	0	0	0	0	5	4	80	1	20	0	0
Hancock Bend Light	722.7	5	4	80	1	20	0	0	5	4	80	1	20	0	0	0	0	5	4	80	0	0	1	20
Troy Hill Light	730.6	7	5	71	1	15	1	14	7	4	57	3	43	0	0	0	0	7	6	86	0	0	1	14
Owensboro waterworks	756.5	9	8	89	1	11	0	0	9	8	89	1	11	0	0	0	0	9	7	78	1	11	1	11

Larkin Ferry Light	760.0	9	7	78	2	22	0	0	9	7	78	2	22	0	0	0	0	9	8	89	1	11	0	0
Dam No. 47	777.7	9	8	89	0	0	1	11	9	7	78	2	22	0	0	0	0	9	8	89	1	11	0	0
Evansville waterworks	791.0	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	9	100	0	0	0	0
Dutch Bend Light	797.7	8	4	50	1	12	3	38	8	8	100	0	0	0	0	0	0	8	8	100	0	0	0	0
Henderson waterworks	803.0	8	3	38	1	12	4	50	8	8	100	0	0	0	0	0	0	8	7	88	1	12	0	0
Dam No. 48	809.0	8	4	50	3	38	1	12	8	8	100	0	0	0	0	0	0	8	8	100	0	0	0	0
Mount Vernon waterworks	829.1	8	7	88	0	0	1	12	8	8	100	0	0	0	0	0	0	8	7	88	1	12	0	0
Dam No. 49	845.0	8	7	88	1	12	0	0	8	8	100	0	0	0	0	0	0	8	7	88	1	12	0	0
Browns Island Light	852.0	8	8	100	0	0	0	0	8	8	100	0	0	0	0	0	0	8	7	88	1	12	0	0
Greens Crossing Light	865.0	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	7	78	2	22	0	0
DeKoven Light	870.7	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	9	100	0	0	0	0
Dam No. 50	876.8	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	8	89	1	11	0	0
Rosiclaire waterworks	891.6	9	8	89	0	0	1	11	9	9	100	0	0	0	0	0	0	9	7	78	2	22	0	0
Golconda waterworks	902.5	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	6	67	3	33	0	0
Old Maids Crossing Light	918.0	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	7	78	2	22	0	0
Ledbetter Light	927.3	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	8	89	1	11	0	0
Paducah waterworks	934.3	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	8	89	0	0	1	11
Dam No. 52	938.9	9	9	100	0	0	0	0	9	9	100	0	0	0	0	0	0	9	9	100	0	0	0	0
Dam No. 53	962.6	9	8	89	1	11	0	0	9	9	100	0	0	0	0	0	0	9	9	100	0	0	0	0
Cairo waterworks	978.0	7	7	100	0	0	0	0	7	7	100	0	0	0	0	0	0	7	6	86	1	14	0	0
Cairo Point	981.0	7	4	57	2	29	1	14	7	7	100	0	0	0	0	0	0	7	6	86	1	14	0	0

[1] And Steve Green Landing.

TABLE OH–5B.—*Main Ohio River: Average phenol results*

Sampling point	Date 1940	Number samples	Average temperature ° C.	Phenol, parts per billion
Emsworth Dam	October	1	17.8	1.6
		7	16.2	([1])
	November	5	9.1	4.0
		1	9.3	([1])
	December	2	4.6	4.3
		2	3.8	([1])
Dashield Dam	September	1	17.2	([1])
	October	1	14.8	([1])
Montgomery Dam	November	1	14.0	([1])
Dam No. 7	September	1	19.5	([1])
	October	1	13.5	([1])
	November	1	7.0	1.0
Dam No. 8	January (1941)	1	5.0	8.8
Dam No. 9	October	1	17.5	([1])
	November	2	6.8	([1])
	December	1	3.0	4.4
Dam No. 10	September	1	18.5	([1])
	December	5	4.6	11.7
		1	5.7	([1])
	January (1941)	1	5.7	17.6
Dam No. 11	December	3	3.6	12.7
		1	5.7	([1])
Dam No. 13	October	6	15.5	([1])
	November	4	7.7	17.0
		2	8.5	([1])
	December	7	4.7	17.8
	January (1941)	1	5.2	12.8
Dam No. 14	May	6	15.4	8.5
		4	18.4	([1])
	June	9	22.5	([1])
	July	10	24.4	([1])
	August	1	24.3	1.6
		10	25.2	([1])
	September	4	22.2	([1])
Dam No. 15	May	1	13.0	6.4
Dam No. 16	June	1	18.2	([1])
Argand Landing	May	3	14.5	2.7
		2	19.6	([1])
	June	1	24.5	([1])
	July	2	23.8	([1])
	August	2	27.0	([1])
	September	2	23.8	([1])
Dam No. 22	May	1	11.7	2.1
		1	20.2	([1])
Dam No. 23	do	4	15.7	4.5
		4	16.8	([1])
	June	4	19.8	([1])
Point Pleasant	February	2	2.5	2.6
	March	1	5.0	3.8
	April	1	7.0	11.5
Gallipolis Dam	February	2	1.8	4.8
	March	3	3.9	6.5
		3	3.2	([1])
	April	1	8.0	([1])
Dams Nos. 27 and 28 [2]	February	1	1.7	22.8
		2	4.0	([1])
	March	2	6.0	8.8
		2	7.0	([1])
Dam No. 29	February	2	2.0	3.2
	March	1	2.0	([1])
Dams Nos. 30 and 31 [2]	February	1	.7	22.4
Dam No. 31	do	1	1.8	16.0
Dam No. 32	do	3	2.6	([1])
	March	1	4.5	1.3
		5	4.0	([1])
	April	1	8.0	([1])

[1] Less than 1.0.
[2] Composite samples.

Fig. Oh-8

(Face p. 222) No. 1 GPO-43 O-9035

(Face p. 222) No. 2 GPO-43 O-9035

Fig. Oh-9

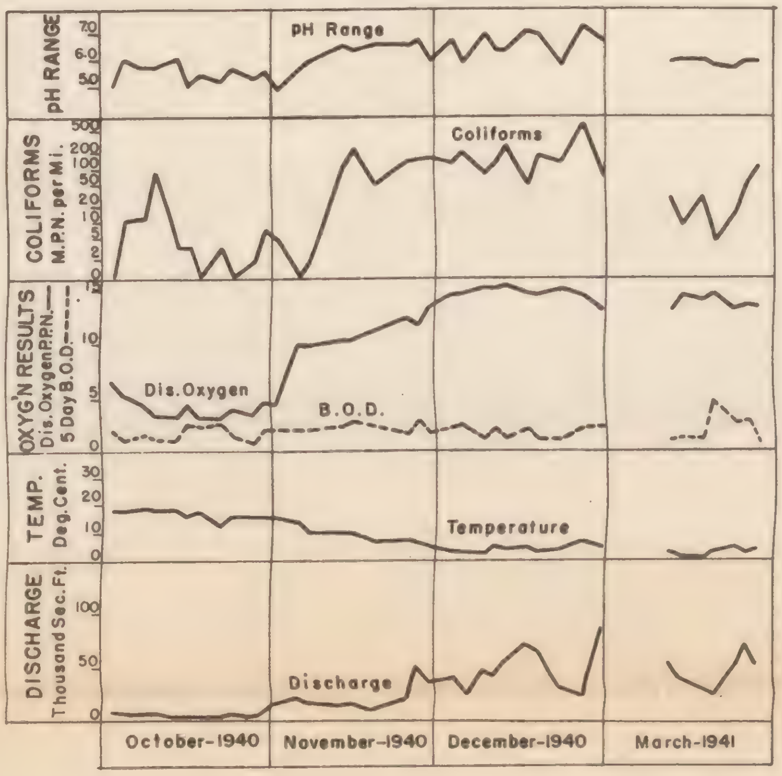
Fig. Oh-10

(Face p. 222) No. 3 GPO-43 0-9035

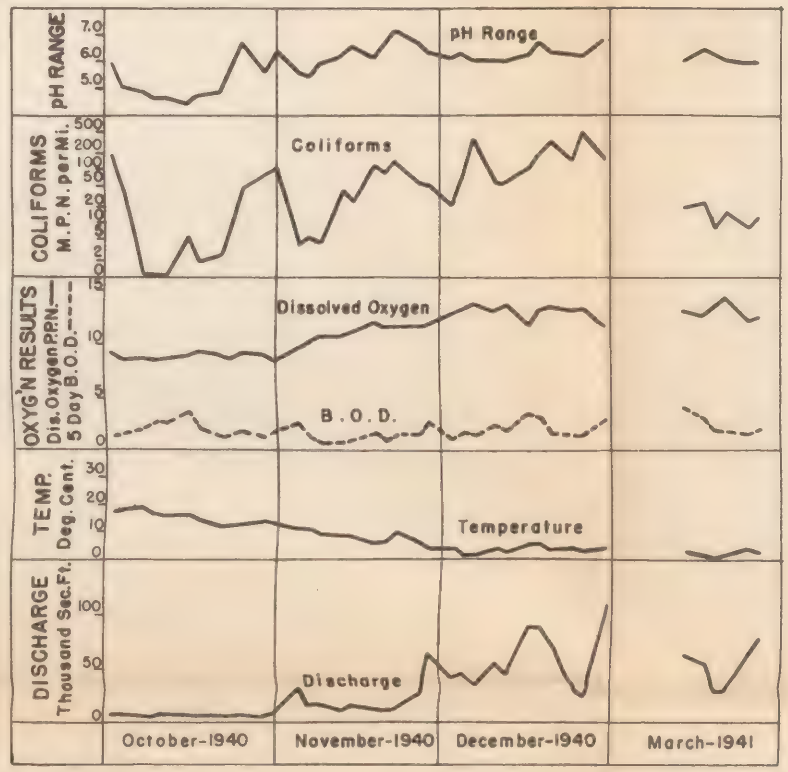
Fig. Oh-11

OHIO RIVER LABORATORY RESULTS
AT INDIVIDUAL STATIONS

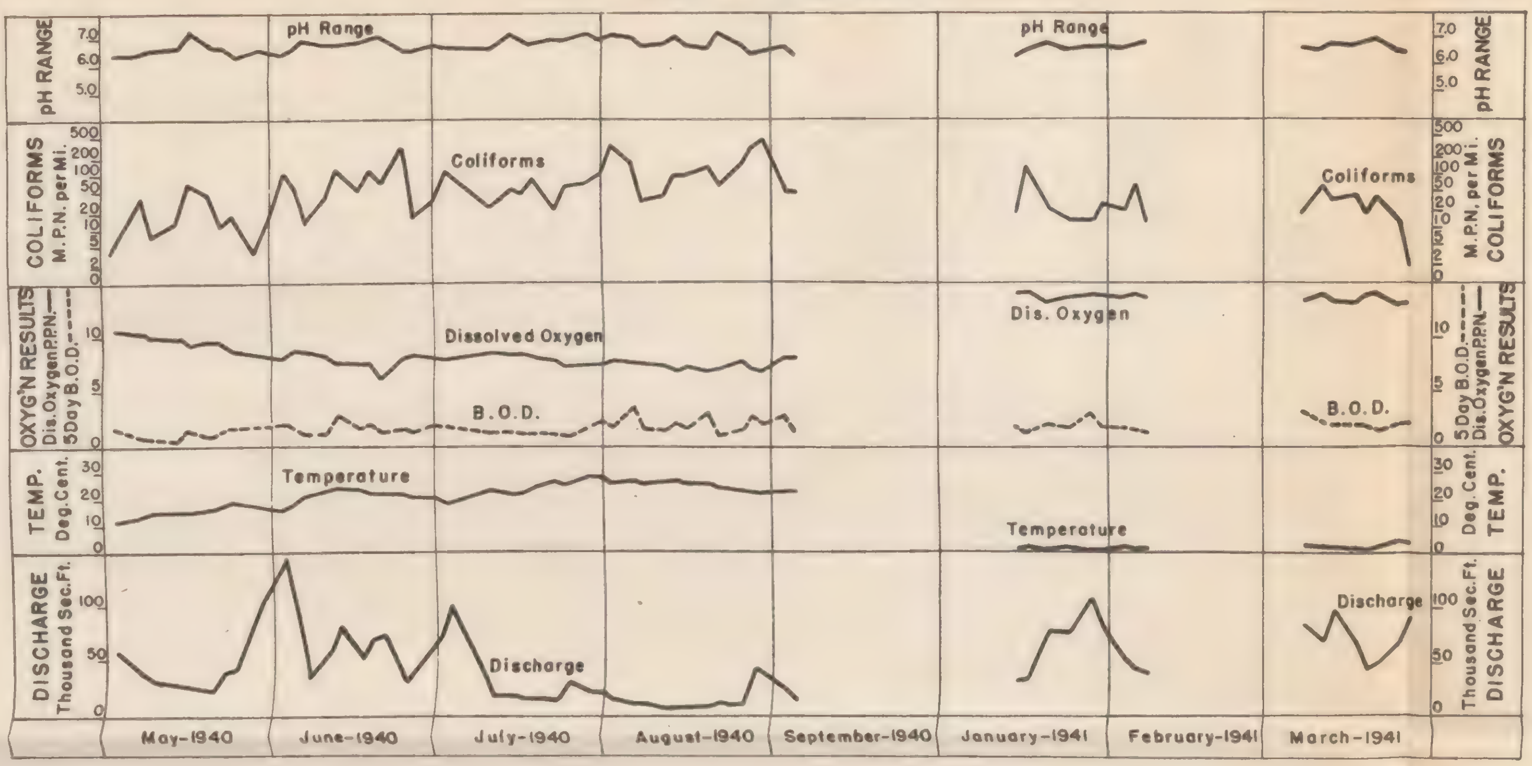
EMSWORTH DAM (STA.-6.0)
BELOW PITTSBURGH



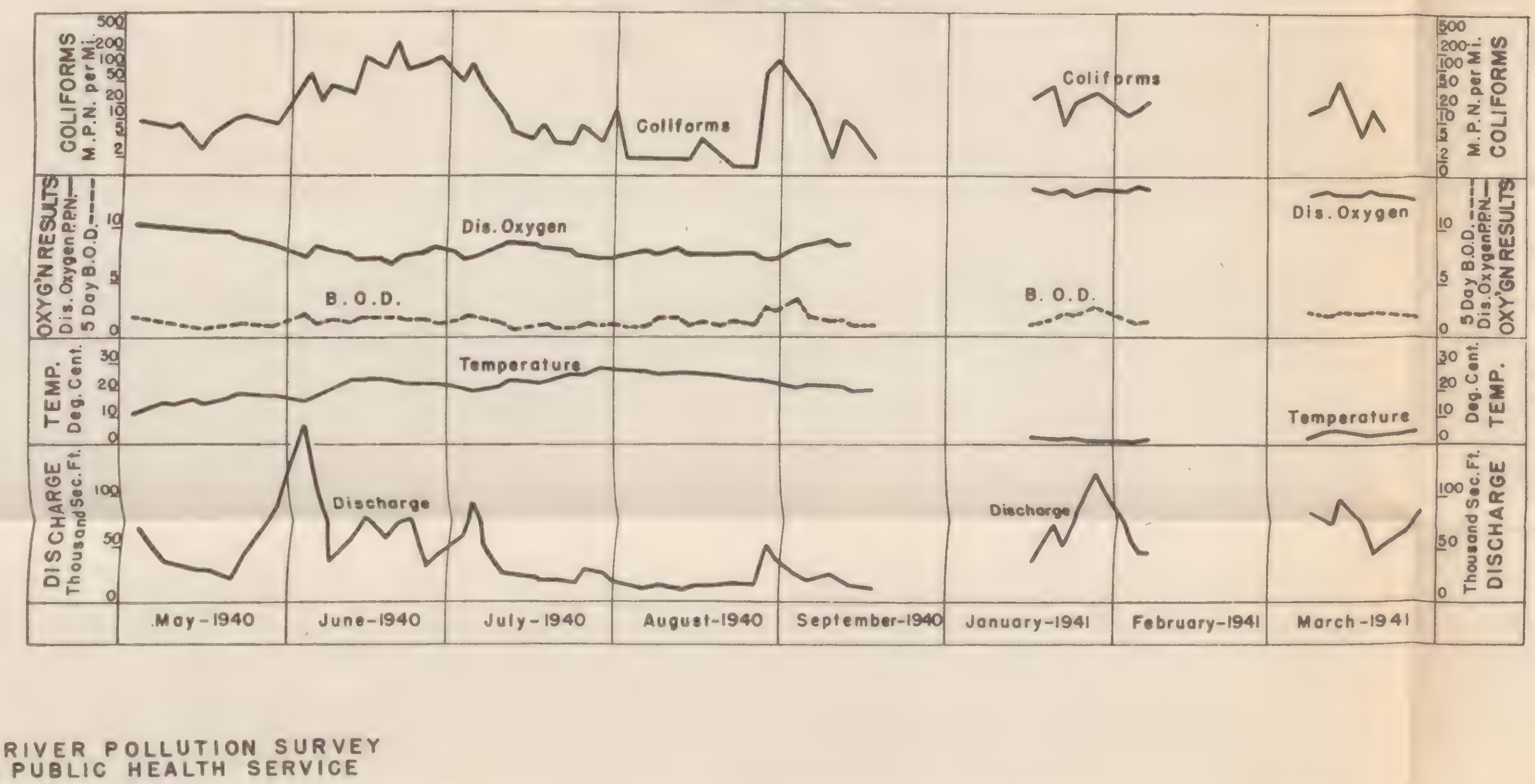
DAM No. 13 (STA.-96.0)
BELOW WHEELING



RAPPS RUN LIGHT (STA.-185.0)
BELOW PARKERSBURG



DAM No. 23 (STA.-231.5)
MILLWOOD W. VA.



OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

Acid stream conditions were observed in the river above Marietta, Ohio, during the summer and fall months when volumes of discharge were low. A summary of the acid results is included in table Oh–7A (p. 256). Acid doubtless influenced the laboratory results at times in the upper portion of the river. The effects of the highly acid Monongahela upon the Ohio immediately below its junction with the Allegheny are shown below. The extremely large decrease in coliforms and oxygen demand at Emsworth in October, as compared with November and December, when the acid concentrations were lower, suggests the effect of acid upon the bacterial concentrations in the river.

Station	Miles from Point Bridge, Pittsburgh	Discharge (cubic feet per second)	pH	Temperature	Quantity units [1]			Flow time (hours)
					Dissolved oxygen	Biochemical oxygen demand	Coliforms	
				October 1940				
Allegheny	1.7	2,900	6.2	16.6	10.72	13.33	1,690	
Monongahela	.5	2,710	4.0	18.6	11.38	5.69	181	
Total		5,610			22.10	19.02	1,871	
Emsworth	6.0	5,460	5.6	16.3	21.80	6.00	66	52.80
Dashield	13.5	5,710	6.6	16.0	44.50	6.30	57	39.03
				November 1940				
Allegheny	1.7	10,600	7.0	9.6	110.00	28.60	4,820	
Monongahela	.5	14,500	5.6	11.6	127.60	36.20	377	
Total		25,100			237.60	64.80	5,197	
Emsworth	6.0	23,660	6.2	9.0	244.00	47.30	2,510	14.18
Dashield	13.5	23,270	6.3	8.3	256.00	51.10	2,164	11.96
				December 1940				
Allegheny	1.7	31,200	6.7	1.3	477.00	53.00	1,248	
Monongahela	.5	21,800	6.3	4.0	257.00	45.80	131	
Total		53,000			734.00	98.80	1,379	
Emsworth	6.0	51,350	6.7	4.4	755.00	92.40	10,680	6.26
Dashield	13.5	51,070	6.6	3.8	705.00	102.00	5,362	5.83

[1] Quantity units=concentration×discharge in thousand second-feet.

The effects of phenol waste products upon the taste and odor problems of public water supplies are well known. Previous investigations have shown that tastes may be produced by phenols in excess of 1 part per billion and that waters containing more than 10 parts per billion are not suitable for public use. Also phenolic wastes, if highly concentrated, have a toxic effect upon the biological life in the stream and hence retard natural purification processes. A summary of all phenol determinations made on the main Ohio River is shown on table Oh–5B. Phenols in excess of 1 part per billion were observed

in samples below East Liverpool, Steubenville, and Wheeling in the colder months of November–December 1940 and January 1941, and at Point Pleasant and Gallipolis Dam in February, March, and April 1940. Phenols of from 2 to 8 parts per billion were observed at dams 14, 15, 22, and 23 in May 1940. The results seem to indicate intermittent discharge of phenolic wastes. There is also some indication that temperature plays an important part in the persistence of these wastes in the stream, more rapid disappearance being observed during the warmer months.

Oxygen conditions in the Pittsburgh-Huntington stretch of the Ohio River at the time of sampling were generally good, the large majority of samples having oxygen demands of less than 3 parts per million and dissolved oxygen contents of more than 6.5 parts per million. Coliform results on the other hand show a relatively high concentration, counts in excess of 200 per milliliter being recorded at times at all stations except the three just above Huntington.

The heaviest pollution occurred below Pittsburgh, Wheeling, and Parkersburg. Evidence of natural purification was observed in the 53-mile section between dams 14 and 17 and in the 70 miles between dams 23 and 27. Reductions in number of coliform bacteria and in oxygen demand were noted in these stretches during the periods of sampling. The percentage of total number of samples showing less than 50 coliforms per milliliter increased from 51 to 84 percent between dams 13 and 17 and from 81 to 96 percent between dams 23 and 27.

Seven major tributaries enter the Ohio between Pittsburgh and Huntington including the Allegheny and Monongahela Rivers which join to form the Ohio. In order, proceeding downstream, the other streams are the Beaver, Muskingum, Little Kanawha, Hocking, and Kanawha Rivers. Comparing the results at stations above and below these tributaries little, if any, effect was noted on the Ohio at the time of sampling, except as noted above at the junction of the Allegheny and the Monongahela.

The findings of the laboratory survey of this section may be summarized briefly as follows:

(1) Zones of pollution were observed in the Pittsburgh-Wheeling area and below Parkersburg.

(2) Definite zones of recovery due to natural purification were observed between dams 14 and 17 and dams 23 and 27.

(3) Acid conditions were found during low flows in the Ohio River as far downstream as dam 17.

(4) Because of acid concentration, the measurable effect of sewage and organic industrial pollution below Pittsburgh and Wheeling was less than otherwise would be expected, although relatively high densities of coliform bacteria were observed at some points.

(5) Relatively high concentrations of taste-producing phenols were observed at various points throughout the entire section, especially during the cooler months. Evidence of progressive diminution in these concentrations was noted during the warmer months.

(6) With the exception of the Allegheny and Monongahela Rivers the sanitary quality of the water of the major tributary streams, at their mouths, was as good or better than that of the main stream and the inflow had little or no effect on the main stream during the time of the present investigation. The tributaries were more alkaline

than the Ohio River and tended to reduce the acidity or increase the alkalinity of the main stream.

HUNTINGTON TO CINCINNATI

This section of the river is characterized by a succession of small cities in the 50-mile stretch from Huntington to Portsmouth and a relatively sparsely settled valley in the 100 miles between Portsmouth and Cincinnati. Three major tributaries enter the Ohio in this stretch, the Guyandot, the Big Sandy, and the Scioto. Ashland, Ironton, and Portsmouth take their water supplies from the river in the upper portion of this section and Cincinnati, Covington, and Newport from the extreme lower end. The major sanitary problem in the Huntington-Cincinnati area is one of high bacterial pollution affecting the quality of the raw water used for public supplies (see fig. Oh–7 and table Oh–5A). At dam 29 (mile 320 below Pittsburgh) 21 percent of the samples showed coliform counts in excess of 200 per milliliter and above Ironton (mile 326 below Pittsburgh) 26 percent of the samples were in this group during the sampling period of this survey. At dam 36 just above Cincinnati counts were over 200 per milliliter 6 percent of the time of sampling and were less than 50 per milliliter 77 percent of this time.

The dissolved-oxygen results were generally good in this area with saturation values of 85 percent or higher at all sampling stations during most of the period of observation. The oxygen-demand averages were low, rarely exceeding 2.0 parts per million and usually being about 1.0 part per million, except during high-water periods when some increases were noted.

The most significant indication regarding the high degree of bacterial pollution in the Huntington-Portsmouth area is the evidence that the pollution is largely of local origin. High-water results with increased velocities and shorter times of flow indicate only a moderate increase in coliform organisms above Huntington which might be attributed to upstream pollution. There is a tendency for the coliform counts to level off during the high-water period in passing through this district, with the average maximum occurring at dam 32 (see fig. Oh–7 and table Oh–5). This figure also indicates the reduction in coliform bacteria between dams 31 and 36 during low-water periods. There appears to be little recovery between dams 32 and 36 during the high-water period.

Phenol determinations made during the period from February to April are summarized on table Oh–5B. Phenols in excess of 1 part per billion were present at all stations at some time during the sampling period. Maximum concentrations in excess of 20 parts per billion were recorded at dams 27, 28, 30, and 31.

All of the important tributary streams in this section of the Ohio had relatively high coliform counts during the June to October period. The Guayandot and Big Sandy samples were undoubtedly influenced by sewage from Huntington and Catlettsburg. Inflow from the Scioto increased the alkalinity of the Ohio River markedly. Comparing the results of observations at stations immediately above and below tributary streams, there do not appear to have been any marked changes in the sanitary quality of the Ohio River due to contributions of the tributaries during the period of sampling.

The observations in the Huntington-Cincinnati section of the river may be summarized briefly as follows:

(1) The Huntington-Cincinnati section of the main Ohio River is characterized by a considerable amount of pollution of local origin originating in the area from Huntington to Portsmouth.

(2) A zone of self-purification existed in the river from Portsmouth to dam 36 during low-flow periods, which was not apparent during periods of high discharge.

(3) Phenols were present in the area from dam 27 to dam 32 during the colder months of the year.

(4) Tributaries entering this section were observed to have high coliform counts during the warmer months with lower concentrations in the cooler months of higher stream flow. The inflow of tributaries did not appear to cause any marked changes in the sanitary quality of the main stream.

CINCINNATI TO LOUISVILLE

This 118-mile section of the river receives a large amount of pollution at its upper end from the Cincinnati metropolitan area, and additional pollution from several minor sources between Cincinnati and Madison. In the 40-mile stretch between Madison and Louisville the river receives little or no pollution.

Four major tributaries enter the Ohio River in this section, the Little Miami, Licking, Miami, and Kentucky Rivers. The Little Miami and Licking Rivers, receiving sewage from the Cincinnati area in their lower reaches, and the Miami River from upstream pollution, contributed appreciable pollution loads to the Ohio River. The Kentucky River appeared to be a relatively clean stream. The higher alkalinities of the Miami and Kentucky Rivers tended to increase somewhat the alkalinity of the main stream below their confluences.

More extensive laboratory observations were made in the section from Cincinnati to dam 39, particularly in the Cincinnati pool, than in the lower end of this river section where observations were confined to three series of observations by mobile laboratory units in July-August and October 1940, and January-February 1941. For this reason the laboratory findings on these two parts of the river section are discussed separately.

The effects of pollution from the Cincinnati area on the upper portion of this section of the river are indicated as follows:

(1) Increases in maximum averages of coliform organisms ranging from about 2,000 to 60,000 per milliliter at times of low flows and from 100 to 400 per milliliter at times of high water.

(2) Decreases in dissolved oxygen below the city to minimum monthly average values of 3.8 to 5.4 parts per million with individual samples approaching total depletion in September 1939. During the months of low water temperatures and in the summer months when river flows were high and open channel conditions existed, dissolved oxygen results in the Cincinnati area were satisfactory.

(3) Oxygen demand averages usually less than 3 parts per million with some individual results above 6 parts per million. A shore line survey by the city of Cincinnati close to the many sewer outlets showed very high oxygen demand values in the immediate vicinity of these sources of pollution.

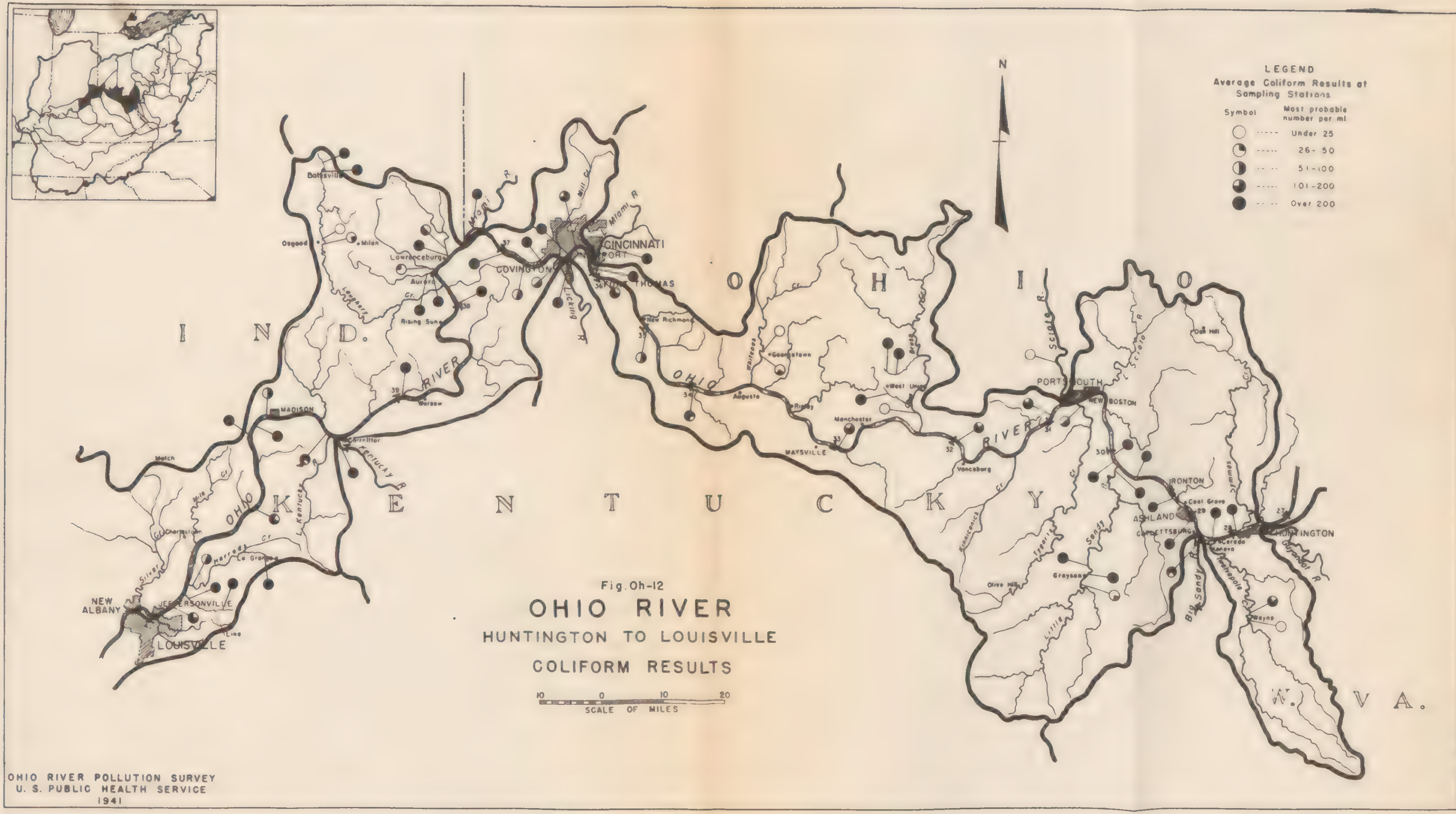


Fig. Oh-12
OHIO RIVER
HUNTINGTON TO LOUISVILLE
COLIFORM RESULTS

(Face p. 226) No. 1 GPO-43 O-9035

Fig. Oh-12

Fig. Oh-13

(Face p. 226) No. 2 GPO-43 0-9035

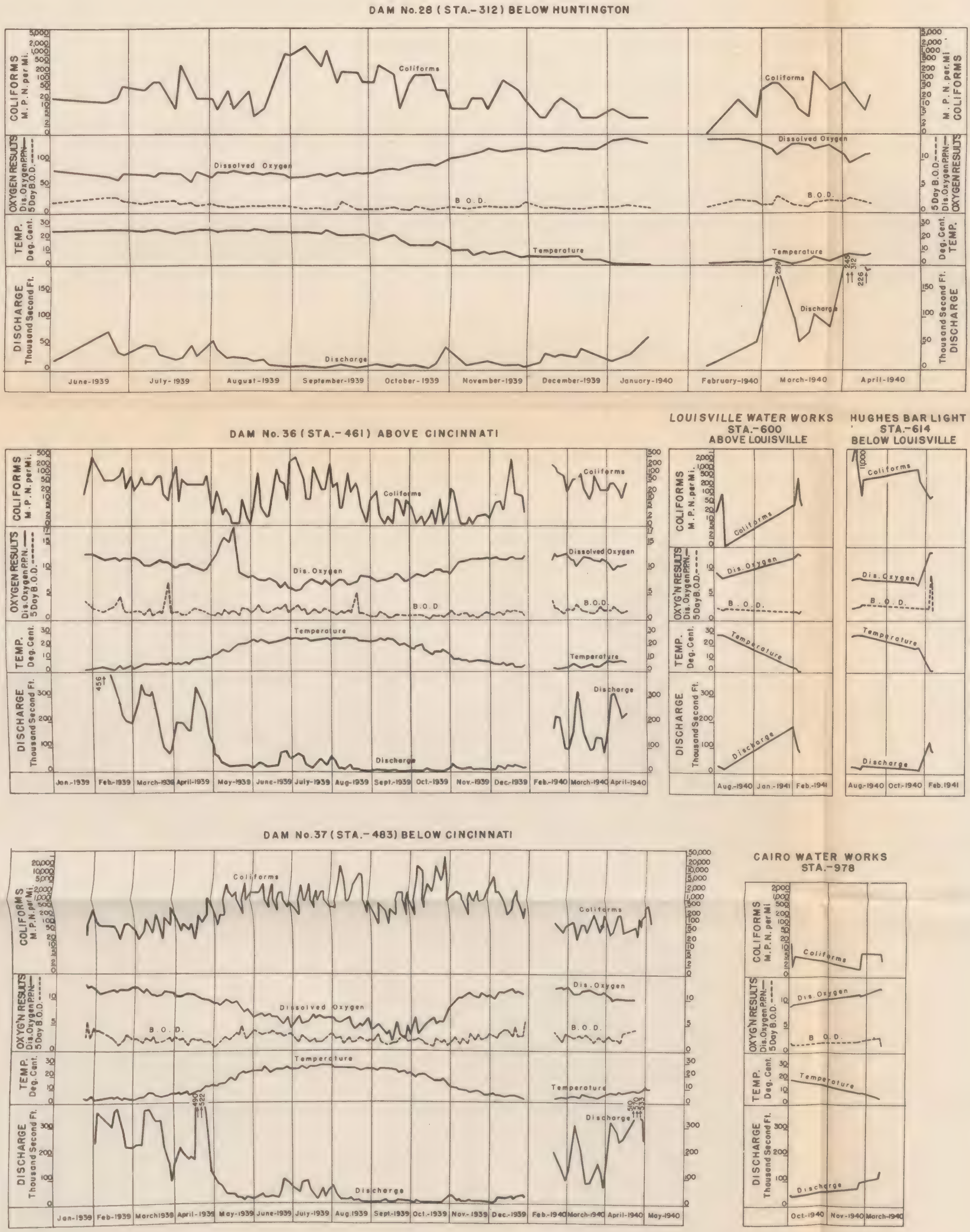
Fig. Oh-14

OHIO RIVER
HUNTINGTON TO LOUISVILLE
BIOCHEMICAL OXYGEN DEMAND

(Face p. 226) No. 3 GPO-43 0-8035

Fig. Oh-14

OHIO RIVER LABORATORY RESULTS
AT INDIVIDUAL STATIONS



OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

(4) Increases in dissolved oxygen to approximately 85 percent saturation and decreases in oxygen demand to between 2 and 3 parts per million occurred below dam 37 with natural purification much more marked in the summer low-flow period than during high water—low temperature conditions. During high flows coliform organisms reached their maximum at dam 38, moving upstream to Riverside below Mill Creek with higher water temperatures and lower flows. The following tabulation indicates the effect of stream flow and water temperatures on the location of the maximum concentration of coliform organisms below Cincinnati:

Number of months observed	Average discharge range, thousand second-feet	Percent of time maximum average coliform counts appeared at—			
		Riverside (475)	Dam 37 (483)	Dam 38 (503)	Dam 39 (532)
2	Under 15	100.0			
3	15 to 30	33.3	66.7		
3	31 to 75 [1]	66.7	33.3		
6	Over 75 [1]	16.7		67.3	16.7
	Average temperature range ° C.	Percent of time maximum average coliforms appeared at—			
		Riverside	Dam 37	Dam 38	Dam 39
8	Under 15° C	25.0	12.5	50.0	12.5
6	15° C., and over	66.7	33.3		

[1] Pool stage ceases and open-channel conditions obtain at flows over approximately 60,000 cubic feet per second.

In the section below dam 39 an increase in coliform concentration is indicated immediately below Madison, especially marked during the July and August study but less marked in October and January. Dissolved oxygen saturation increased from dam 39 to Louisville in July with a slight depression at Madison and fairly high dissolved oxygen saturations were observed in October and January. Oxygen demand results varied from about 2 to 3.5 parts per million, being in excess of 3 parts per million more frequently in the cooler months. Nearly 60 percent of the samples at the Louisville waterworks intake had coliform counts in excess of 50 per milliliter.

LOUISVILLE TO MOUTH

The heaviest zones of pollution in the lower river were found immediately below Louisville and in the Evansville-Henderson district with smaller sources of pollution at Owensboro, Paducah, and Cairo. Five major tributaries enter the Ohio River in this section, the Salt, Green, Wabash, Cumberland, and Tennessee.

At the time of sampling, oxygen conditions throughout the section were good, even below the larger communities. Some depression in dissolved oxygen was noted in August and October 1940 below Louisville with recovery at dam 43, about 25 miles downstream. This depression was not noted in February 1941 despite a sharp increase in oxygen demand below Louisville which was probably due to the rapid rise in the river at this time (fig. Oh–7, Oh–15 and table

Oh–5). The dissolved oxygen remained near or above saturation throughout the remainder of the section.

Oxygen demands were, for the most part, below 3 parts per million, even below Louisville, except during the period of observation in January, February, and March 1941 when disturbed flow conditions apparently brought about erratic results with averages approaching 5 parts per million. The coliform results reached their highest averages in the 10-mile stretch below Louisville in October 1940. Sharp increases also appeared below Owensboro in October, below Evansville in August and October, and below Cairo in all three observational periods. Figure Oh–7 and table Oh–5 show the relatively cleaner waters existing in the lower reaches of the river. All tributaries entering the section are in good sanitary condition at their mouths.

Marked evidence of self-purification is indicated in the long, relatively unpolluted stretch between Louisville and Evansville, as measured both by oxygen demand and by coliform reductions. In the extreme lower portion of the river little evidence was observed of the heavy pollution loads placed upon the stream between Pittsburgh and points within 200 miles of the mouth of the Ohio, thus showing the ability of the stream to cleanse itself by natural means of the successive loads of untreated wastes discharged to it. Except for the two areas below Louisville and Evansville, this section of the Ohio River was found to be relatively clean at the time of sampling.

Biological summary.—The results of the bilogical survey of the Ohio River indicated—

(1) The plankton population of the Ohio River was characteristically different from that of the tributaries. The Ohio supports large numbers of diatoms of genera not prominent in the tributaries. Modifying these conditions was the acidity of the upper river which resulted in closteriopsis, a form dominating the acid waters of the Monongahela River, which extended its range downstream in the acid waters to Marietta, Ohio.

(2) The plankton population of the main Ohio River was generally lower than that of the tributaries with the exception of the Green and Cumberland Rivers. Acid conditions in the upper river reduced the volume of plankton considerably as far downstream as Marietta during the period of observation. A tendency toward a gradual increase in plankton was observed downstream from Marietta, with a slight peak below Cincinnati and indications of a peak below Louisville due to the increase in fertility below these cities.

Hydrometric Data

Although continuous, long-term records of gage heights are available at many points along the Ohio River, reliable flow records are lacking. This is especially true of low flow data which are of particular interest in this survey. At Pittsburgh since 1923, at Huntington since 1934, and at Louisville since 1928 low flow records are fairly accurate. Prior to those dates the records are less trustworthy. Flows during 1930 were by far the lowest of dependable record at Pittsburgh and Louisville and 1939 was the second driest year, based on minimum monthly average flows. Table Oh–6 shows the flow at three stations during the driest summer months of record.

Fig. Oh-16

OHIO RIVER
LOUISVILLE TO MOUTH
COLIFORM RESULTS

Fig. Oh-17
OHIO RIVER
LOUISVILLE TO MOUTH
DISSOLVED OXYGEN RESULTS

Fig. Oh-17

(Face p. 228) No. 2 GPO-43 0-90035

Fig. Oh-18

OHIO RIVER
LOUISVILLE TO MOUTH
BIOCHEMICAL OXYGEN DEMAND

(Face p. 228) No. 3 GPO-43 0-9035

Fig. Oh-18

TABLE OH–6.—*Main Ohio River: Monthly mean summer flows for years in which low summer flows have occurred*

Location	Pittsburgh, Pa.	Huntington, W. Va.	Louisville, Ky.
River miles above mouth of Ohio	981	674	374
Drainage area, square miles	19, 100	55, 200	91, 200
Period of record	1923–40	1934–40	1928–40
Year:	1930	1939	1930
June ..... cubic feet per second	10, 000	39, 800	25, 300
July ..... do	3, 300	39, 600	8, 000
August ..... do	1, 300	20, 400	4, 900
September ..... do	1, 400	7, 840	6, 000
Year:	1939	1936	1939
June ..... cubic feet per second	15, 500	15, 100	68, 920
July ..... do	13, 400	16, 300	70, 440
August ..... do	6, 100	15, 600	33, 180
September ..... do	3, 040	11, 500	8, 590
Year:	1929	1934	1932
June ..... cubic feet per second	14, 000	----------	33, 500
July ..... do	12, 000	----------	99, 800
August ..... do	4, 000	34, 900	27, 200
September ..... do	4, 000	12, 700	8, 650

A study of gage heights, precipitation records and tributary stream flow indicates that the 1930 flows were probably the lowest experienced in the Ohio River since about 1860.

Low-flow regulation.—Reservoir sites on tributaries of the Ohio River have been studied by the United States Engineer Department in connection with the authorized program for flood control in the Ohio Basin. The possible use of these reservoirs for low-flow regulation has been considered and is discussed in reports on the various tributaries. The reservoirs on the Allegheny and Monongahela Rivers and their tributaries above Pittsburgh would be of particular value to pollution abatement if operated for low-flow control. These reservoirs could aid in control of acid pollution as pointed out in the section of the report on acid mine drainage.

DISCUSSION

From the data presented it is apparent that the most important effect of pollution reaching the Ohio River is the unduly heavy bacterial loadings placed on many of the 30 water purification plants along the stream. Effects of somewhat lesser importance are the taste and odor difficulties at the water plants, the general loss of recreational values, the occasional destruction of fish life and the nuisance conditions due to occasional oxygen depletion below the largest cities, and to scum, floating solids, and discoloration of the stream at these and many smaller places.

Comparison of results of various surveys.—No previous surveys of Ohio River tributaries comparable to the present one have been made. No laboratory data therefore are available from which to determine

pollution trends for any considerable portion of the watershed outside the main Ohio River.

Investigations of limited portions of the main river were made in 1914–15, and in 1929–30 prior to the present study. Previous surveys covered longer periods of time but the main river sections studied were relatively short and represented only a small percentage of the 981 miles of river. The present survey has been more extensive in its scope, covering the entire watershed, but the analytical data collected at any one particular station have of necessity been limited.

Lack of comparable data is therefore the greatest factor in preventing studies of past and present conditions along the river. Of considerable importance also is the difference in laboratory technique between the first and last survey, which to a considerable extent prevents comparisons between the oxygen demand results, indicative of the organic pollution load on the stream. Complicating the laboratory procedures, both chemical and bacteriological, for examinations of water in the upper Ohio, are the presence and variation in concentration of acid. In many instances comparable sampling points are lacking.

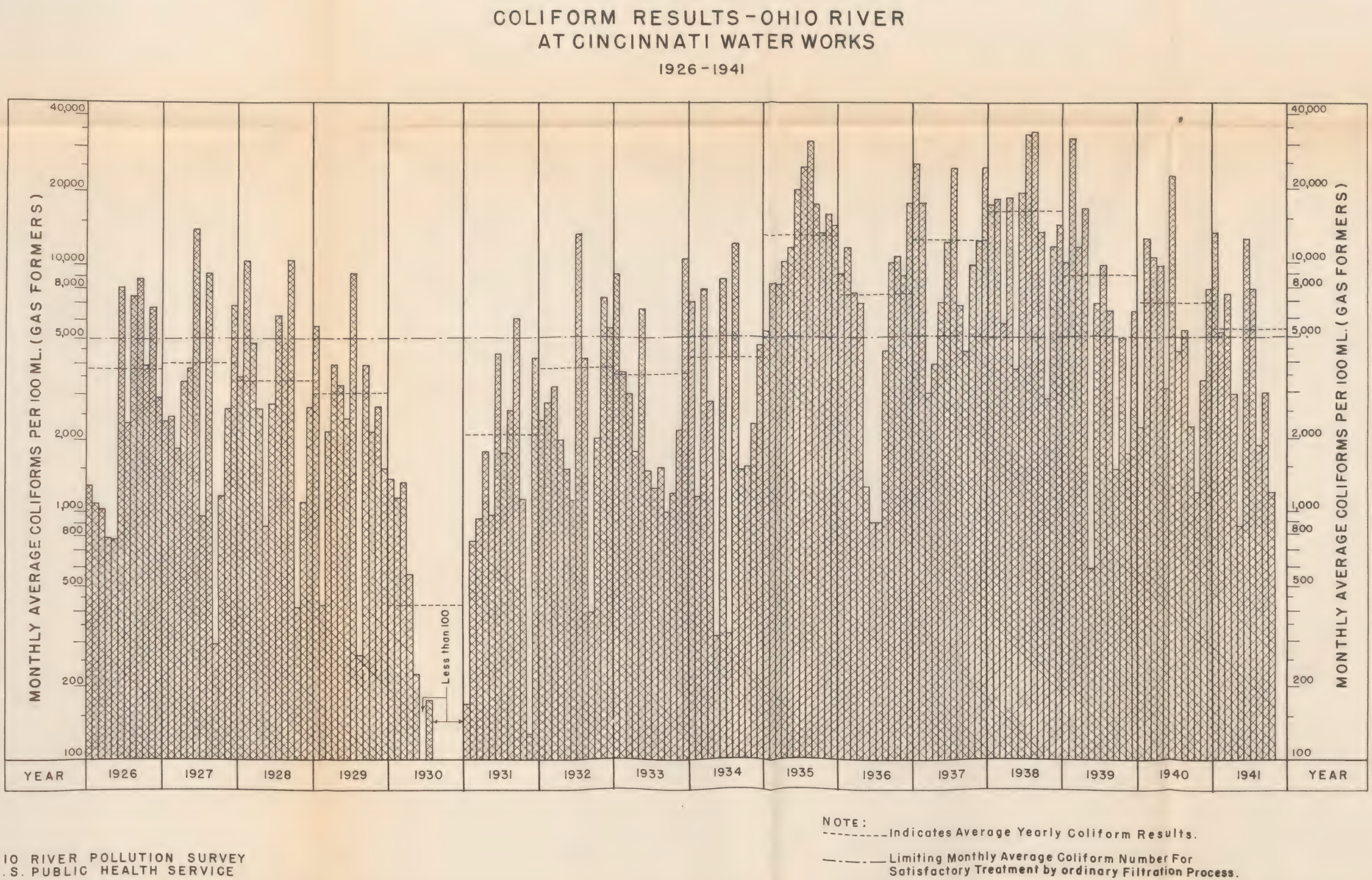
During the summer periods of pool stage with the navigation dams in operation, measurements of stream discharge are less accurate and the pools, acting as sedimentation basins, remove by deposition varying amounts of suspended matter, depending on the amount of flow through and the distribution of velocities in the pools. Many of these dams have been constructed since the earlier surveys and some in existence in 1914–15 have since been replaced, further complicating the comparison of the results of the various surveys.

The most striking change in the river since the original survey, and one about which there can be no doubt, has been the increase in acid concentration in the upper Ohio River. Acid mine drainage, and to a lesser degree spent acid liquors from manufacturing processes, now affect the river as far down stream as the mouth of the Kanawha River (mile 266)[2]. On numerous occasions the water supply of Pomeroy, Ohio (mile 248)[2], has been affected by acid in the river water. Water plants in the acid zone have experienced definite increases, not only in acid concentration but in the duration of the acid periods. During the 1914 survey, acid conditions were occasionally observed as far downstream as Wheeling, W. Va. (mile 90)[2]. If the increasing acid trend continues without abatement, it is believed the main river as far downstream as the Scioto River (mile 356)[2] may become acid occasionally.

The records of raw water coliform examinations at some of the Ohio River water plants constitute the only continuous long-time records of the quality of Ohio River water. Changes in location of intakes and in laboratory methods make comparisons at some of the plants impossible.

Monthly average raw water coliform results at the Cincinnati water plant from 1926 to 1941 are shown in figure Oh–19. These data are expressed in terms of the Phelps Index rather than as Most Probable Numbers (M. P. N.), since the early results were available only in this form. These data show that during every year since 1935 the annual average coliform counts have exceeded the safe

[2] River miles below Pittsburgh.



OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1942

average for treatment by ordinary filtration and chlorination. Additional treatment and careful operation have made possible the production of drinking water of satisfactory bacterial quality, but the water is often unpalatable. A number of other water supplies from the river are much more heavily polluted.

During the 25 years since the first survey of the pollution of the Ohio River the population of the basin, as a whole, has increased by about 22 percent and the population adjacent to the Ohio River by about 24 percent. A larger proportion of the population is served by sewers now than was in 1915, but progress in sewage treatment has been marked. Because the recently completed survey of sewered communities was more complete than that of the earlier survey, the figures shown below are not strictly comparable, but they probably represent the changes that have occurred within about 5 percent.

Population	1914–15 survey	Present survey	Percent increase
Entire Ohio Basin:			
Total	15,381,000	18,824,000	22
Urban	5,694,600	8,222,300	44
Served by sewers	4,106,600	8,561,200	108
To treatment plants	483,900	2,913,000	502
Untreated	3,622,700	5,618,200	55
Ohio River and minor tributaries:			
Total	3,308,900	4,091,100	24
Urban	2,062,900	2,709,100	31
Served by sewers	1,680,500	[1] 2,822,200	68
To treatment plants	27,700	[1] 133,000	380
Untreated	1,652,800	[1] 2,689,200	63

[1] These figures cover an area comparable with that of the 1914–15 survey which differs slightly from similarly named areas considered in this report.

From these data it can be seen that the amount of waste material of human origin reaching the Ohio River and its tributaries has increased by 20 to 60 percent during the past 25 years. No comparable figures for changes in the industrial waste load are available.

The factor that has probably been most influential in focusing attention on the pollution problem of the Ohio River Basin is the periodic taste in municipal water supplies. This is caused in part by certain microscopic organisms whose presence cannot be definitely attributed to pollution but which thrive best in water recovering from pollution and in part by chemical compounds discharged by such industries as byproduct coke plants, some chemical manufacturing plants, oil refineries, and wood-preserving plants. Although these industries existed in 1914, all of them have grown rapidly during the past 25 years and, in spite of recovery and treatment measures aimed at reducing or eliminating the discharge of taste-producing wastes conditions in general are probably worse today than in 1914. No analytical data are available to substantiate this, however. The increasing public consciousness of tastes and the increasing public demand for more palatable water add to the seriousness of the problem. Improvement in water treatment processes has done much toward overcoming tastes, but practical considerations demand that further improvements be made at the sources of the trouble.

The increase in acidity and in taste troubles in public water supplies have been the most perceptible changes in the quality of the Ohio

River during the past 25 years. Increased sewage and organic industrial waste pollution has been less noticeable, due largely to the fact that the flow in the Ohio is sufficient to prevent grossly offensive conditions during a large part of the time.

Ohio River Valley Water Sanitation Compact.—One of the major factors hindering the progress of pollution abatement along the Ohio River is the lack of any governmental agency with adequate statutory power to carry on an effective program with respect to the stream. This is due largely to its interstate character. Except for its upper 40 miles, which are in Pennsylvania, the river forms State boundaries. West Virginia and Kentucky, a part of the original Thirteen States, claimed ownership of the river and as a result the State boundary is at the low water line on the right bank of the river. Thus Ohio, Indiana, and Illinois have no jurisdiction over the stream.

Efforts at joint action by the agencies of the various States engaged in pollution abatement work in the Ohio Basin date from 1924 when a conference of State health commissioners was held to consider methods of eliminating or satisfactorily treating phenolic wastes which were causing tastes and odors in public water supplies. In that same year a cooperative agreement was entered into by the varous State health departments and through their concerted effort considerable progress was made in controlling phenolic waste. The agreement had no legal status and no progress was made in controlling sewage pollution or that resulting from other types of industrial wastes.

In 1936 the Congress authorized [3] the negotiation of an interstate compact between the States of the Ohio River Basin. The compact was drafted, approved by the Congress,[4] and ratified by the State legislatures of Illinois, Indiana, Kentucky, New York, Ohio (whose ratification becomes effective when New York, Pennsylvania, and West Virginia enter into the compact) and West Virginia (whose ratification becomes effective when New York, Ohio, Pennsylvania, and Virginia enter into the compact). It becomes effective upon ratification by five States and consequently requires either ratification by Pennsylvania or removal of the qualifications placed on their ratifications by Ohio and West Virginia.

The principal provisions of the compact [5] are—

Article 1: Each signatory State pledges cooperation in controlling and abating pollution and agrees to enact any necessary legislation.

Article 2: Creates "Ohio River Valley Water Sanitation District" comprising all of the Ohio River Basin within the signatory States.

Article 3: Creates "Ohio River Valley Water Sanitation Commission."

Article 4: Commission to consist of three members from each State and three representing the Federal Government.

Article 5: Commission to elect officers, may hire and discharge employees, establish offices, etc. Shall report annually to various State Governors on activities.

Article 6:

> It is recognized by the signatory States that no single standard for the treatment of sewage or industrial wastes is applicable in all parts of the District due to such variable factors as size, flow, location, character, self-purification, and usage

[3] Public Res. No. 104, 74th Cong., approved June 8, 1936.
[4] Public, No. 739, 76th Cong., approved July 11, 1940.
[5] Signed by compact commissioners for Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee, and West Virginia.

of waters within the District. The guiding principle of this compact shall be that pollution by sewage or industrial wastes originating within a signatory State shall not injuriously affect the various uses of the interstate waters as hereinbefore defined.

All sewage from municipalities or other political subdivisions, public or private institutions, or corporations, discharged or permitted to flow into these portions of the Ohio River and its tributary waters which form boundaries between, or are contiguous to, two or more signatory States, or which flow from one signatory State into another signatory State, shall be so treated, within a time reasonable for the construction of the necessary works, as to provide for substantially complete removal of settleable solids, and the removal of not less than 45 percent of the total suspended solids: *Provided*, That in order to protect the public health or to preserve the waters for other legitimate purposes, including those specified in article 1, in specific instances such higher degree of treatment shall be used as may be determined to be necessary by the Commission after investigation, due notice, and hearing.

All industrial wastes discharged or permitted to flow into the aforesaid waters shall be modified or treated, within a time reasonable for the construction of the necessary works, in order to protect the public health or to preserve the waters for other legitimate purposes, including those specified in article 1, to such degree as may be determined to be necessary by the Commission after investigation, due notice, and hearing.

All sewage or industrial wastes discharged or permitted to flow into tributaries of the aforesaid waters situated wholly within one State shall be treated to that extent, if any, which may be necessary to maintain such waters in a sanitary and satisfactory condition at least equal to the condition of the waters of the interstate stream immediately above the confluence.

The Commission is hereby authorized to adopt, prescribe, and promulgate rules, regulations, and standards for administering and enforcing the provisions of this article.

Article 7: Compact does not limit power of States to require higher degrees of treatment.

Article 8: Commission shall conduct a survey of the district and make a comprehensive report; shall draft and recommend legislation to State Governors; shall consult with States, municipalities, industries, etc., on pollution problems.

Article 9:

The Commission may from time to time, after investigation and after a hearing, issue an order or orders upon any municipality, corporation, person, or other entity discharging sewage or industrial waste into the Ohio River or any other river, stream, or water, any part of which constitutes any part of the boundary line between any two or more of the signatory States, or into any stream any part of which flows from any portion of one signatory State through any portion of another signatory State. Any such order or orders may prescribe the date on or before which such discharge shall be wholly or partially discontinued, modified or treated, or otherwise disposed of. The Commission shall give reasonable notice of the time and place of the hearing to the municipality, corporation, or other entity against which such order is proposed. No such order shall go into effect unless and until it receives the assent of at least a majority of the commissioners from each of not less than a majority of the signatory States; and no such order upon a municipality, corporation, person, or entity in any State shall go into effect unless and until it receives the assent of not less than a majority of the commissioners from such State.

It shall be the duty of the municipality, corporation, person, or other entity to comply with any such order issued against it or him by the commission, and any court of general jurisdiction or any United States district court in any of the signatory States shall have the jurisdiction, by mandamus, injunction, specific performance, or other form of remedy, to enforce any such order against any municipality, corporation, or other entity domiciled or located within such State or whose discharge of the waste takes place within or adjoining such State, or against any employee, department, or subdivision of such municipality, corporation, person, or other entity: *Provided, however*, Such court may review the order and affirm, reverse, or modify the same upon any of the grounds customarily applicable in proceedings for court review of administrative decisions. The

Commission or, at its request, the Attorney General or other law-enforcing official, shall have power to institute in such court any action for the enforcement of such order.

Article 10: States agree to appropriate their proportion of Commission budget prorated one-half in proportion to population and one-half in proportion to land area within the district.

Article 11: Compact to become effective when ratified by legislatures of majority of States and approved by Congress.

Desirable degree of treatment.—General application of the compact minimum requirement of substantially complete removal of all settleable solids and removal of at least 45 percent of the suspended solids from all sewage and industrial wastes discharged directly to the Ohio River should be ample to prevent serious oxygen depletion at any place on the Ohio River except Cincinnati under present conditions of waste loads and stream flow. Even in the Cincinnati area conditions would be satisfactory except during periods of extremely low flow. A marked reduction in the acidity of the Ohio River at Pittsburgh would greatly increase the effects of organic pollution and necessitate a higher degree of treatment unless the stream flow during the warm weather months was increased appreciably. At these two places designs for the larger plants should include provisions for more than primary treatment, probably by the addition of coagulants. At all of the larger municipalities and at any of the smaller ones whose sewage would appreciably affect downstream water intakes, continuous chlorination of the treatment plant effluents should be provided for the reduction of bacterial pollution. At places where wastes are being discharged to tributary streams near their junction with the Ohio River, more complete treatment may be necessary to correct local conditions unless the outfalls are extended to the Ohio River.

Low-flow control by means of flood control and multiple-purpose reservoirs in the area above Pittsburgh and Cincinnati might eliminate the need for more than primary treatment of sewage and equivalent treatment of organic industrial wastes at these places. The flow required at Pittsburgh to accomplish this (assuming an effective acid-control program) has been estimated at 8,000 cubic feet per second during the warm summer months (25° C. or 77° F. average monthly air temperature) and progressively lesser flows as temperatures decrease. The savings in costs resulting from the use of primary treatment rather than the higher degree of treatment using chemical coagulants is estimated at $300,000 per year at Pittsburgh and an additional $300,000 per year at Cincinnati.

Studies by the United States Engineer Department indicate that such flows could be maintained except during such an extremely dry year as 1930 by using existing reservoirs and additional ones above Pittsburgh authorized by the Congress for low-flow control in conjunction with their major purpose of flood control. At Cincinnati, a considerably smaller increase in flow would insure satisfactory conditions with only primary treatment. Existing reservoirs, together with those above Pittsburgh, could provide this increased flow.

The bulk of the organic industrial wastes should be treated at municipal plants. In general, removal of settleable solids as required by article 6 of the compact should assure adequate industrial waste treatment except at oil refineries, byproduct coke plants, and a few

other plants where particular attention should be given to those components likely to cause tastes and odors in public water supplies. At plants such as steel mills, acid wastes should be neutralized during periods when their contribution to the acid load on the stream is significant. However, as mine drainage contributes by far the greater acid load, acid mine control by sealing should be well advanced before even part-time neutralization of pickle liquor is justified.

The larger cities along the Ohio River are aware of the necessity of sewage treatment and many of them have made studies to determine how they can most economically collect and treat their wastes. Consulting engineers have recently prepared preliminary plans and estimates for Cincinnati and Louisville. Pittsburgh, Evansville, Wheeling, and Huntington had previously studied their sewerage problems.

Pittsburgh.—The problem of waste treatment in the Pittsburgh district is highly complicated and cannot be effectively solved by the city alone. Some kind of authority or sanitary district comprising the greater part of Allegheny County is almost essential to an economical and thorough pollution abatement program in this area. The county contains 125 cities, boroughs, and townships, many of which necessarily use joint sewers. The intensive development of the narrow stream valleys limits the number of available sites for sewage treatment plants. The report of the General Committee on Sewage of the Municipalities of Allegheny County, prepared in 1939, outlines a plan for 19 treatment plants on the lower Allegheny and Monongahela Rivers, the Ohio River and two smaller streams, Turtle Creek and Chartiers Creek. Much more detailed investigation of alternate plans is necessary before any final decision can be made as to the best plan. The largest plant in any case will almost certainly be at a site on Brunots Island where most or all of the sewage from the city of Pittsburgh, as well as from a number of adjoining boroughs and townships, would be treated. Interceptor costs will be high since most construction will be in rock and a considerable part of it will be in tunnel. The estimated cost of interceptors and 19 primary treatment plants in the committee report is $35,900,000. These would serve most of Allegheny County. Costs as summarized in table Oh–1 include only those plants on the Ohio River in the Pittsburgh area. The costs of other plants in the metropolitan area are included in summaries of costs in the Allegheny and Monongahela Basins.

Cincinnati.—Comprehensive studies of the pollution problem of Cincinnati and its suburbs in Ohio have been made and preliminary plans and estimates have been prepared. Cincinnati has made more progress toward solution of its pollution problem than any other large Ohio River city. Plans call for the ultimate construction of 4 plants which would treat the wastes of the city and 17 incorporated suburbs as well as a large unincorporated area in Hamilton County. The first plant to be constructed would treat the wastes now entering the Little Miami near its mouth and the Ohio in the upper part of the city. These wastes may affect the water supplies of Cincinnati, Covington, and Newport which are taken from the Ohio within a mile upstream from the mouth of the Little Miami. Interceptors for this plant are almost complete. The proposed plant will have a capacity of about 25 million gallons per day and will

provide primary treatment and chlorination with provisions for later additions to increase its capacity and to provide more complete treatment.

The largest plant of the four would be located in Mill Creek Valley a short distance from the Ohio River. Its capacity would be about 108 million gallons per day. It would treat most of the sewage from Cincinnati and its suburbs and, in addition, large amounts of industrial wastes which make the combined wastes about twice as strong as normal municipal sewage. The plant as planned would provide primary treatment and chlorination with provisions for increases in capacity and in degree of treatment.

The other two plants would be much smaller with a total capacity of about 5 million gallons per day. They would serve the lower end of the city and adjoining areas in the county. They would provide the same degree of treatment as the larger plants and their construction would be deferred until the larger plants were completed.

The total capital cost of the entire program is estimated at about $19,000,000.

Little progress has been made toward pollution abatement in the Kentucky communities across the river from Cincinnati. A number of the smaller communities which drain to small wet-weather streams have installed treatment plants, but the bulk of wastes still enters the Ohio and Licking Rivers untreated. Cooperative effort seems necessary to any economical program of waste treatment, but numerous attempts to form special districts for such work have failed.

Louisville.—The recently completed consulting engineers' report on sewage treatment for Louisville proposes a single primary treatment plant to serve the city and some of its suburbs. A large industrial waste load would be treated with the domestic sewage. The plant would have a capacity of about 73 million gallons per day. The estimated capital cost for interceptors and treatment is about $6,000,000. The report suggests operation only during low-flow periods. No provision is made for chlorination of the effluent. Because of the short sedimentation period provided (1 hour at average design flow) and part-time operation, such a plant would not meet the minimum requirements in article 6 of the compact, nor would it provide adequate protection to the New Albany, Ind., water supply. If provisions for chlorination were added and the plant operated continuously it should effectively reduce bacterial pollution below Louisville.

These three large metropolitan areas are the key ones in a program for abatement of pollution in the Ohio River. Although the need for sewage treatment is equally acute at many other communities along the upper Ohio, at Huntington, Ashland, and other places where bacterial pollution is affecting downstream public water supplies, it is proper for the larger places to take the lead.

Cost.—The cost of a suggested program providing for primary treatment of all wastes entering the Ohio is summarized in table Oh–1. This suggested program is based on the assumption that low-flow control will make more complete treatment at Pittsburgh and Cincinnati unnecessary. An estimate of the comparative cost of a program for complete treatment of all wastes is included in table Oh–1.

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Ohio River, Emsworth Dam.	O 6	October 1940	11	5,460	16.3	4.0	1.1 [1] 1.6	12	5.6	8	7	....
Do	do	November 1940	9	23,660	9.0	10.3	2.0 [1] 1.8	106	6.2	16	15	....
Do	do	December 1940	11	51,350	4.4	14.7	1.8	208	6.7	37	13	....
Do	do	March 1941	7	47,750	2.5	13.9	2.2	40	6.1	26	10	....
Dashield lock and dam	O 13.5	October 1940	11	5,710	16.0	7.8	1.1 [1] 1.4	10	6.6	7	8	....
Do	do	November 1940	9	23,270	8.3	11.0	2.2 [1] 1.6	93	6.3	18	13	....
Do	do	December 1940	11	51,070	3.8	13.8	2.0	105	6.6	41	11	....
Do	do	March 1941	7	47,140	2.3	12.9	1.9	38	6.0	25	7	....
Beaver River, mouth	O 25.4 (1.4 miles above mouth of Beaver River)	October 1940	11	633	15.2	8.3	2.6	802	6.2	13	33	....
Do	do	November 1940	8	1,797	8.6	11.0	1.8	141	6.5	25	40	....
Do	do	December 1940	11	6,228	4.8	12.5	2.7	380	6.7	54	30	....
Montgomery Dam	O 31.7	October 1940	11	6,100	16.0	8.3	.9 [1] 1.1	20	5.6	7	8	....
Do	do	November 1940	9	24,990	8.8	11.0	1.6	58	6.2	16	15	....
Do	do	December 1940	9	60,180	3.1	13.8	2.0	102	6.5	39	15	....
Do	do	March 1941	7	53,510	2.4	13.3	2.0	43	6.0	32	9	....
Lock and dam No. 7	O 36.5	October 1940	11	6,110	16.0	10.0	1.0 [1] 1.1	27	5.7	6	9	....
Do	do	November 1940	9	24,330	8.8	12.2	1.5 [1] 1.4	47	6.3	19	14	....
Do	do	December 1940	10	61,900	3.3	14.1	2.1	103	6.5	50	12	....
Lock and dam No. 8	O 46.4	October 1940	12	6,530	15.8	9.8	.9 [1] 1.0	47	5.6	4	7	....
Do	do	November 1940	9	24,580	8.8	11.8	1.6 [1] 1.2	43	6.2	21	14	....
Do	do	December 1940	9	64,610	3.8	13.8	2.2 [1] 1.7	99	6.4	59	12	....
Do	do	March 1941	6	53,320	2.7	13.7	2.4	68	6.0	31	9	....
Lock and dam No. 9	O 56.1	October 1940	12	6,510	15.3	9.7	1.1 [1] 1.1	31	5.5	3	9	....
Do	do	November 1940	9	24,430	8.8	11.6	1.7 [1,2] 1.4	35	6.2	17	14	....
Do	do	December 1940	10	64,650	3.7	13.7	2.3	98	6.4	58	13	....

[1] Seeded and neutralized.
[2] Only 2 results.

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Lock and dam No. 10	O 66	October 1940	12	6,500	16.3	9.4	1.2 [1] 1.5	30	5.4	4	9	----------
Do	do	November 1940	10	23,160	9.1	11.5	1.8 [1,2] 1.6	29	6.2	14	14	----------
Do	do	December 1940	12	59,430	4.5	13.5	1.9	97	6.4	47	12	----------
Do	do	March 1941	6	54,080	2.2	13.5	2.1	30	6.1	28	10	----------
Lock and dam No. 11	O 77	October 1940	12	6,480	16.3	8.3	1.8 [1] 2.8	61	5.3	5	5	----------
Do	do	November 1940	10	22,920	9.3	11.4	1.7 [1,2] 2.0	26	6.2	16	13	----------
Do	do	December 1940	12	60,160	4.3	13.5	2.2	76	6.4	51	12	----------
Do	do	March 1941	6	54,480	2.5	13.5	1.8	22	6.1	28	9	----------
Lock and dam No. 12	O 87.5	October 1940	12	6,540	15.7	8.6	1.3 [1] 1.6	10	5.3	6	5	----------
Do	do	November 1940	10	22,680	9.5	11.3	1.6 [1,2] 2.0	22	6.3	16	12	----------
Do	do	December 1940	12	60,910	4.7	13.1	2.1	94	6.4	47	12	----------
Lock and dam No. 13	O 96	October 1940	12	6,450	15.6	8.9	1.5 [1] 2.1	43	5.3	6	6	----------
Do	do	November 1940	10	22,490	8.9	11.2	1.5 [1,2] 2.0	59	6.3	17	14	----------
Do	do	December 1940	12	61,520	4.8	13.0	2.2	207	6.4	56	15	----------
Do	do	March 1941	6	55,260	2.2	13.2	2.7	18	6.2	28	13	----------
Lock and dam No. 14	O 114	May 1940	12	39,050	15.9	9.7	1.1	11	5.3	20	8	----------
Do	do	June 1940	10	41,510	22.0	8.2	1.2	435	6.8	62	16	----------
Do	do	July 1940	10	19,630	24.4	8.0	.8	33	6.6	20	15	----------
Do	do	August 1940	11	10,450	25.1	7.4	.9 [1] .8	15	4.9	13	13	----------
Do	do	September 1940	5	9,740	21.7	8.6	.8 [1] .9	(3)	4.6	7	3	----------
Do	do	January 1941	6	51,780	2.4	13.4	2.0	33	6.4	39	15	----------
Do	do	February 1941	2	30,120	2.2	13.2	1.4	34	6.5	----------	----------	----------
Do	do	March 1941	9	55,860	3.2	13.4	2.0	16	6.5	39	12	----------
Lock and dam No. 15	O 129	May 1940	12	40,400	15.5	9.7	1.0	7	4.9	32	8	----------
Do	do	June 1940	10	43,470	22.2	8.3	1.1	81	6.8	43	16	----------
Do	do	July 1940	10	20,210	24.7	8.3	.9	44	6.7	49	18	----------
Do	do	August 1940	11	11,000	25.1	7.7	1.0 [1] .8	93	5.4	39	13	----------
Do	do	September 1940	5	9,700	21.8	8.6	.8 [1] .8	(3)	4.7	7	5	----------
Do	do	January 1941	6	55,000	2.3	13.8	1.8	17	6.4	39	13	----------

Do	do	February 1941	2	28,950	2.0	13.2	1.3	16	6.6	26	14	
Do	do	March 1941	9	57,960	2.9	13.6	1.8	21	6.5	44	11	
Lock and dam No. 16	O 146.5	May 1940	12	41,930	16.6	9.7	1.0	7	5.3	32	7	
Do	do	June 1940	10	45,060	22.2	8.2	1.0	57	6.8	63	16	
Do	do	July 1940	10	20,880	24.2	8.4	1.0	28	6.7	35	18	
Do	do	August 1940	11	11,640	25.2	7.7	1.1 [1] 1.0	23	5.6	26	14	
Do	do	September 1940	5	9,660	21.9	8.8	.9 1.9	4	4.8	6	4	
Do	do	January 1941	6	58,520	2.5	13.8	1.9	18	6.4	37	12	
Do	do	February 1941	2	27,600	2.1	13.6	1.2	20	6.6	22	14	
Do	do	March 1941	9	60,070	3.3	13.6	1.7	11	6.4	43	11	
Lock and dam No. 17	O 167.5	May 1940	11	42,240	16.0	9.6	1.0	4	5.2	39	7	
Do	do	June 1940	10	45,880	22.2	8.1	1.6	122	6.6	135	16	
Do	do	July 1940	9	21,890	24.9	8.3	1.4	75	7.0	63	22	
Do	do	August 1940	11	12,800	26.4	7.6	1.2 1.9	26	6.2	44	12	
Do	do	September 1940	5	11,200	22.4	8.8	1.0 1.9	3	5.1	8	6	
Do	do	January 1941	7	53,460	1.6	13.8	2.0	13	6.3	33	12	
Do	do	February 1941	2	29,440	1.5	13.6	1.3	8	6.5	19	14	
Do	do	March 1941	9	61,480	2.2	13.4	1.8	15	6.4	46	10	
Muskingum River, mouth, dam No. 1.	O 172.2 (0.2 mile above mouth of Muskingum River).	May 1940	11	9,784	16.0	9.7	1.8	14	7.3	66	85	
Do	do	June 1940	10	11,982	22.2	8.6	1.6	156	7.5	240	80	
Do	do	July 1940	9	5,689	25.5	8.2	1.9	28	7.6	56	100	
Do	do	August 1940	11	2,050	26.4	7.5	2.0	13	7.6	59	102	
Do	do	September 1940	5	3,360	21.5	8.3	1.3	12	6.7	46	80	
Do	do	January 1941	7	8,620	1.6	14.1	1.4	107	7.4	36	84	
Do	do	February 1941	2	10,510	1.2	13.9	1.1	122	7.5	38	76	
Do	do	March 1941	8	7,996	2.3	13.6	1.3	49	7.6	47	84	
Argand Landing, below Mariette and Muskingum Rivers.	O 173.5	May 1940	10	43,610	16.1	9.9	1.1	14	6.6	56	22	
Do	do	June 1940	10	64,300	22.1	8.3	1.5	112	7.2	137	39	
Do	do	July 1940	10	31,440	25.4	8.4	1.4	44	7.2	45	49	
Do	do	August 1940	10	15,000	26.6	7.7	1.4	123	7.1	45	41	
Do	do	September 1940	6	16,230	22.3	8.7	1.1	24	6.5	23	26	
Do	do	January 1941	6	63,400	1.6	13.8	1.8	34	6.8	58	38	
Do	do	February 1941	3	42,800	1.6	13.8	1.3	27	7.1	30	44	
Do	do	March 1941	8	65,400	2.5	13.5	1.6	20	6.8	51	24	
Lock and dam No. 18	O 180	May 1940	9	41,530	16.4	9.7	1.1	7	6.6	45	22	
Do	do	June 1940	10	64,300	22.0	8.2	1.5	76	7.1	137	42	
Do	do	July 1940	10	31,440	25.3	8.3	1.6	30	7.2	45	49	
Do	do	August 1940	11	15,000	26.3	7.7	1.6	78	7.1	54	41	
Do	do	September 1940.	6	16,230	22.2	8.6	1.3	32	6.5	19	32	
Do	do	January 1941	6	63,400	1.6	13.9	1.5	23	6.8	41	37	
Do	do	February 1941	3	42,800	1.6	13.8	1.3	31	7.0	28	42	
Do	do	March 1941	8	65,400	2.4	13.4	1.7	20	6.9	48	34	

[1] Seeded and neutralized. [2] Only 2 results. [3] Less than 1.

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen, parts per million	5-day bio-chemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Congress Landing, above Parkersburg, W. Va., and Little Kanawha River.	O 183	May 1940	9	41, 530	16. 1	9. 7	1. 1	8	6. 6	46	21	----------
Do	do	June 1940	10	64, 300	21. 8	8. 2	1. 4	79	7. 0	122	33	----------
Do	do	July 1940	10	31, 440	25. 0	8. 3	1. 4	58	7. 1	42	37	----------
Do	do	August 1940	11	15, 000	26. 0	7. 6	1. 5	66	7. 0	47	32	----------
Do	do	September 1940.	2	18, 810	23. 5	8. 2	2. 8	41	6. 6	34	33	----------
Do	do	January 1941	6	63, 400	1. 5	13. 8	1. 5	14	6. 7	42	26	----------
Do	do	February 1941	3	42, 800	1. 5	13. 8	1. 2	23	6. 9	27	30	----------
Do	do	March 1941	8	65, 400	2. 4	13. 4	1. 7	22	6. 7	49	20	----------
Little Kanawha River, mouth, Baltimore & Ohio R. R. bridge.	O 184.6 (0.1 mile above mouth of Little Kanawha River).	May 1940	9	930	16. 7	7. 8	2. 9	1, 750	6. 7	25	24	----------
Do	do	June 1940	10	4, 846	21. 3	7. 6	1. 7	1, 280	7. 1	289	25	----------
Do	do	July 1940	10	1, 988	25. 0	5. 6	2. 2	1, 040	7. 0	61	30	----------
Do	do	August 1940	11	6, 711	25. 7	2. 2	2. 7	2, 720	7. 0	105	28	----------
Do	do	January 1941	6	4, 918	2. 2	12. 4	2. 2	185	6. 9	98	22	----------
Do	do	February 1941	3	1, 293	1. 8	13. 3	2. 1	23	6. 8	25	17	----------
Do	do	March 1941	8	4, 714	2. 6	13. 0	2. 3	57	6. 9	109	19	----------
Rapps Run Light	O 185	May 1940	9	42, 160	16. 0	9. 6	1. 2	23	6. 6	39	19	----------
Do	do	June 1940	10	69, 140	21. 9	8. 1	1. 7	103	6. 9	120	33	----------
Do	do	July 1940	10	33, 430	24. 9	8. 1	1. 6	70	7. 1	50	37	----------
Do	do	August 1940	11	15, 680	26. 0	7. 5	2. 2	210	7. 0	49	34	----------
Do	do	September 1940.	2	19, 200	23. 5	8. 2	2. 2	53	6. 7	38	33	----------
Do	do	January 1941	6	68, 320	1. 5	13. 8	1. 8	49	6. 7	44	22	----------
Do	do	February 1941	3	44, 090	1. 8	13. 8	1. 4	33	6, 8	39	31	----------
Do	do	March 1941	8	70, 080	2. 3	13. 4	1. 9	29	6. 7	48	22	----------
Lock and dam No. 19	O 192	May 1940	10	42, 400	16. 8	9. 7	1. 4	59	6. 7	41	22	----------
Do	do	June 1940	10	70, 190	22. 8	8. 0	1. 8	119	7. 1	135	32	----------
Do	do	July 1940	12	33, 840	25. 1	8. 2	2. 0	72	7. 3	65	28	----------
Do	do	August 1940	11	16, 700	26. 4	7. 4	1. 6	88	7. 1	49	34	----------
Do	do	September 1940.	6	17, 360	22. 5	8. 3	1. 4	39	6. 5	17	23	----------
Do	do	January 1941	6	73, 600	2. 7	13. 6	2. 0	22	6. 8	64	26	----------
Do	do	February 1941	3	44, 920	2. 0	13. 8	1. 4	42	6. 9	32	29	----------
Do	do	March 1941	7	68, 030	3. 2	13. 3	1. 6	26	6. 8	75	19	----------

Hocking River, mouth, Hockingport.	*O 199.3 (0.1 mile above mouth of Hocking River).*	*May 1940*	*4*	*611*	*18.4*	*8.9*	*1.0*	*24*	*7.2*	*12*	*78*	----------
Do	do	June 1940	4	1,214	23.4	7.8	1.3	133	7.3	120	64	----------
Do	do	July 1940	5	496	25.7	7.6	1.7	68	7.4	98	79	----------
Do	do	August 1940	4	632	25.4	7.6	2.1	124	7.4	92	98	----------
Do	do	September 1940.	2	1,474	20.8	8.3	1.2	24	6.9	20	84	----------
Lock and dam No. 20	O 202.5	May 1940	10	43,130	16.8	9.8	1.6	25	6.7	40	23	----------
Do	do	June 1940	10	71,580	22.2	8.0	1.0	120	7.1	145	31	----------
Do	do	July 1940	12	34,270	24.8	8.2	1.7	62	7.2	69	38	----------
Do	do	August 1940	11	18,530	26.0	7.6	2.0	210	7.2	61	33	----------
Do	do	September 1940.	6	18,360	21.9	8.6	1.6	15	6.6	15	24	----------
Do	do	January 1941	6	75,380	2.3	13.6	2.2	36	6.8	79	26	----------
Do	do	February 1941	3	47,030	2.1	13.8	1.6	34	7.0	33	32	----------
Do	do	March 1941	7	71,380	2.4	13.3	1.9	34	6.7	99	17	----------
Lock and dam No. 21	O 214.5	May 1940	10	43,150	15.8	9.6	1.4	11	6.7	37	24	----------
Do	do	June 1940	10	71,760	21.9	7.9	1.8	188	7.1	194	32	----------
Do	do	July 1940	12	34,600	24.3	8.1	1.5	42	7.2	57	39	----------
Do	do	August 1940	11	19,650	26.0	7.6	1.6	19	7.2	41	33	----------
Do	do	September 1940.	6	19,290	21.5	8.6	1.5	28	6.6	18	26	----------
Do	do	January 1941	6	73,560	2.2	13.1	3.8	33	6.9	54	28	----------
Do	do	February 1941	3	48,290	2.1	13.6	1.4	41	7.0	32	31	----------
Do	do	March 1941	8	70,650	2.9	13.3	2.2	26	6.7	64	19	----------
Lock and dam No. 22	O 221	May 1940	10	43,140	15.7	9.7	1.4	11	6.7	26	23	----------
Do	do	June 1940	10	72,020	21.3	7.7	1.7	115	7.0	194	31	----------
Do	do	July 1940	11	32,970	23.8	8.0	1.4	29	7.2	57	39	----------
Do	do	August 1940	11	20,300	25.6	7.7	1.7	17	7.2	34	33	----------
Do	do	September 1940.	6	19,780	20.9	8.5	1.5	17	6.6	22	24	----------
Do	do	January 1941	6	75,310	2.2	13.6	1.8	37	6.8	49	27	----------
Do	do	February 1941	3	47,460	2.8	13.4	1.6	35	7.0	34	31	----------
Do	do	March 1941	8	70,490	3.7	13.2	2.0	22	6.7	85	18	----------
Lock and dam No. 23	O 231.5	May 1940	8	42,960	16.3	9.8	1.2	8	6.6	30	24	----------
Do	do	June 1940	10	72,200	22.1	7.7	1.7	102	6.9	196	31	----------
Do	do	July 1940	12	34,960	24.4	8.1	1.3	24	7.2	60	36	----------
Do	do	August 1940	11	21,350	26.4	7.9	1.7	22	7.2	31	32	----------
Do	do	September 1940.	6	20,620	21.7	8.7	1.9	15	6.6	24	26	----------
Do	do	January 1941	5	72,690	2.3	13.6	2.0	30	6.8	43	28	----------
Do	do	February 1941	3	48,860	2.0	13.8	1.5	19	7.0	40	31	----------
Do	do	March 1941	8	71,000	3.9	13.2	2.0	18	6.7	63	19	----------
Point Pleasant, W. Va., above Kanawha River.	O 265	August 1939	6	12,600	25.8	6.4	1.7	27	7.3	26	38	----------
Do	do	September 1939.	7	4,600	24.0	6.7	.8	9	7.5	4	45	----------
Do	do	October 1939	9	11,100	17.1	8.4	.8	11	7.4	9	32	----------
Do	do	November 1939.	8	11,000	7.8	11.2	1.0	7	7.0	13	29	----------
Do	do	December 1939	7	22,900	4.9	12.2	.9	22	6.9	8	23	----------
Do	do	January 1940	1	9,430	2.5	13.5	1.2	2	7.1	9	20	----------
Do	do	February 1940	5	109,200	2.4	12.8	2.7	29	6.9	----------	29	----------

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature, ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Point Pleasant, W. Va., above Kanawha River.	O 265	March 1940	7	99, 500	5. 3	12. 8	1. 9	36	6. 9	155	28	
Do	do	April 1940	4	199, 400	8. 3	10. 9	2. 2	24	6. 8	161	21	
Kanawha River, mouth	O 265.7 (0.6 mile above mouth of Kanawha River).	August 1939	6	4, 100	25. 8	5. 2	1. 6	5	7. 3	14	39	
Do	do	September 1939	7	1, 800	24. 1	6. 1	. 8	1	7. 5	6	50	
Do	do	October 1939	9	1, 600	17. 9	7. 3	. 7	3	7. 5	7	46	
Do	do	November 1939	8	1, 900	7. 9	8. 5	. 9	2	7. 2	8	57	
Do	do	December 1939	7	2, 500	5. 0	6. 9	1. 2	1	7. 1	6	64	
Do	do	January 1940	5	2, 300	1. 9	9. 8	2. 5	1	7. 0	45	54	
Do	do	February 1940	5	20, 200	2. 4	12. 7	2. 1	52	7. 0	142	26	
Do	do	March 1940	7	17, 480	5. 3	11. 5	1. 5	34	7. 0	62	28	
Do	do	April 1940	4	28, 420	8. 8	9. 9	1. 6	150	6. 9	82	23	
Gallipolis Dam	O 279	June 1939	2	39, 500	26. 8	5. 9	1. 6	38	7. 3	83	31	
Do	do	July 1939	7	37, 800	25. 3	6. 4	1. 2	23	7. 3	77	40	
Do	do	August 1939	10	18, 300	25. 4	6. 2	1. 1	11	7. 3	33	35	
Do	do	September 1939	6	6, 700	23. 8	6. 4	. 8	2	7. 5	7	47	
Do	do	October 1939	9	12, 900	17. 6	7. 9	. 6	5	7. 5	8	38	
Do	do	November 1939	7	13, 100	8. 0	10. 8	1. 0	5	7. 2	11	33	
Do	do	December 1939	7	26, 100	5. 3	11. 6	. 9	14	7. 1	7	28	
Do	do	January 1940	1	12, 000	. 8		1. 4	2	7. 2	9	37	
Do	do	February 1940	4	126, 800	2. 0	13. 1	2. 2	22	6. 9	175	28	
Do	do	March 1940	6	95, 000	4. 2	12. 8	1. 6	21	6. 9	66	29	
Do	do	April 1940	4	228, 300	7. 8	10. 8	2. 2	24	6. 8	157	20	
Lock and dam No. 27, above Guyandot River.	O 301	June 1939	2	38, 700	26. 5	7. 0	1. 9	24	7. 3	105	33	
Do	do	July 1939	7	38, 100	26. 5	7. 2	1. 5	31	7. 3	95	40	
Do	do	August 1939	10	19, 900	26. 4	7. 3	1. 6	14	7. 3	38	33	
Do	do	September 1939	7	8, 200	24. 7	7. 8	. 8	1	7. 5	5	48	
Do	do	October 1939	9	14, 200	18. 4	8. 9	. 8	2	7. 5	8	37	
Do	do	November 1939	7	14, 500	9. 7	11. 6	1. 4	4	7. 2	11	32	
Do	do	December 1939	6	29, 500	6. 5	12. 2	1. 8	9	7. 0	8	29	
Do	do	January 1940	2	37, 600	1. 0	13. 6	1. 3	23	6. 9	16	26	
Do	do	February 1940	6	115, 400	2. 5	13. 1	2. 5	33	6. 9	156	29	
Do	do	March 1940	7	128, 100	4. 2	12. 6	2. 1	36	6. 9	140	30	
Do	do	April 1940	4	232, 800	8. 1	10. 7	3. 8	29	6. 8	149	22	

Guyandot River, mouth, Cabell County highway bridge.	O 305.2 (0.1 mile above mouth of Guyandot River).	June 1939	2	1,010	25.8	6.8	1.1	350	7.2	405	20	----------
Do	do	July 1939	4	1,455	25.3	7.1	1.1	2,950	7.3	286	23	----------
Do	do	August 1939	4	345	25.8	6.6	1.1	380	7.4	90	36	----------
Do	do	September 1939	5	60	23.6	4.9	2.4	4,600	7.2	15	52	----------
Do	do	October 1939	4	41	17.6	5.3	4.0	3,060	7.5	16	48	----------
Do	do	November 1939	4	52	8.8	9.5	7.4	3,280	7.1	18	48	----------
Do	do	December 1939	4	107	4.4	10.8	3.9	550	7.2	10	59	----------
Do	do	February 1940	2	3,868	4.0	12.3	1.1	236	7.0	66	17	----------
Do	do	March 1940	4	1,435	6.5	11.7	.8	34	6.9	29	19	----------
Do	do	April 1940	2	2,958	11.5	10.2	.7	93	6.6	20	17	----------
Lock and dam No. 28, below Guyandot River.	O 312	June 1939	4	39,300	27.0	6.9	2.6	31	7.3	76	32	----------
Do	do	July 1939	7	39,500	26.3	7.3	1.9	111	7.3	108	41	----------
Do	do	August 1939	10	20,900	26.5	7.4	1.4	241	7.3	48	33	----------
Do	do	September 1939	7	9,000	24.5	7.3	1.0	660	7.5	6	45	----------
Do	do	October 1939	9	14,900	17.9	8.7	.9	142	7.5	7	40	----------
Do	do	November 1939	8	15,100	9.0	11.5	1.2	31	7.2	11	32	----------
Do	do	December 1939	7	31,400	5.9	12.2	1.0	9	7.1	8	29	----------
Do	do	January 1940	3	38,900	.9	13.8	1.2	6	7.0	14	27	----------
Do	do	February 1940	4	48,500	2.5	13.7	1.8	18	6.9	78	31	----------
Do	do	March 1940	7	125,700	4.1	12.6	2.0	72	7.0	152	28	----------
Do	do	April 1940	4	244,200	8.5	10.7	2.2	43	6.8	145	20	----------
Norfolk & Western R. R. bridge.	O 316	June 1939	11	39,200	25.6	7.7	1.9	130	7.3	50	33	----------
Do	do	July 1939	10	39,300	25.8	7.6	1.1	177	----------	----------	----------	----------
Do	do	August 1939	11	20,900	26.3	7.6	.9	218	----------	----------	----------	----------
Do	do	September 1939	10	8,800	24.6	7.5	.9	175	----------	----------	----------	----------
Do	do	October 1939	11	14,600	18.1	8.9	.8	169	----------	6	41	----------
Do	do	November 1939	9	15,100	9.8	11.4	1.0	74	7.2	12	36	----------
Do	do	December 1939	10	31,100	5.7	12.4	1.1	33	----------	----------	----------	----------
Do	do	January 1940	4	33,600	0	14.1	1.0	13	6.9	7	30	----------
Do	do	February 1940	6	142,200	1.8	12.9	2.2	37	----------	----------	----------	----------
Do	do	March 1940	10	136,900	4.1	12.5	1.7	43	6.7	90	27	----------
Do	do	April 1940	5	268,900	7.8	10.8	1.9	44	----------	----------	----------	----------
Big Sandy River, mouth	O 317.1 (0.3 mile above mouth of Big Sandy River).	June 1939	11	2,560	26.9	6.8	1.5	103	7.3	113	40	----------
Do	do	July 1939	10	4,680	26.3	7.0	1.5	61	7.4	266	34	----------
Do	do	August 1939	11	1,020	26.9	7.4	1.4	22	7.6	37	55	----------
Do	do	September 1939	10	210	25.6	6.0	1.2	196	7.5	16	71	----------
Do	do	October 1939	11	109	20.4	6.4	1.2	92	7.7	9	91	----------
Do	do	November 1939	9	104	12.6	6.1	2.1	54	7.3	11	96	----------
Do	do	December 1939	10	133	9.4	7.7	2.0	60	7.4	7	100	----------
Do	do	January 1940	3	570	1.3	12.1	1.1	46	7.0	38	73	----------
Do	do	February 1940	6	5,026	3.4	12.2	1.3	50	7.0	139	23	----------
Do	do	March 1940	10	4,590	6.8	11.4	.9	76	6.9	77	24	----------
Do	do	April 1940	5	7,806	11.6	9.9	.9	59	6.7	82	22	----------

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Lock and dam No. 29, below Big Sandy River.	O 320	June 1939	11	41,500	25.7	7.6	1.7	155	7.3	58	33	----------
Do	do	July 1939	10	42,900	26.0	7.5	1.2	240	7.4	139	36	----------
Do	do	August 1939	11	21,900	26.4	7.6	1.1	280	7.5	41	34	----------
Do	do	September 1939	10	8,900	24.7	7.6	.9	129	7.6	5	49	----------
Do	do	October 1939	11	14,600	16.6	8.9	.8	151	7.7	6	41	----------
Do	do	November 1939	9	15,200	10.0	11.3	1.1	72	7.3	11	33	----------
Do	do	December 1939	10	31,000	5.8	12.4	1.0	49	7.2	10	30	----------
Do	do	January 1940	4	33,900	.2	14.2	1.2	21	6.9	11	33	----------
Do	do	February 1940	6	147,100	2.0	12.9	2.2	36	6.9	202	27	----------
Do	do	March 1940	10	141,100	4.0	12.5	1.7	37	6.8	131	27	----------
Do	do	April 1940	5	266,000	7.7	10.8	2.0	42	6.6	143	20	----------
White Oak Creek	O 326	June 1939	11	41,500	26.1	7.1	1.5	203	7.2	57	31	----------
Do	do	July 1939	9	42,900	26.1	7.2	1.2	192	7.5	62	38	----------
Do	do	August 1939	12	21,900	26.4	7.5	1.0	306	7.4	47	32	----------
Do	do	September 1939.	10	8,900	24.6	7.4	.9	190	7.4	11	45	----------
Do	do	October 1939	11	14,600	18.5	8.9	.9	150	7.5	9	40	----------
Do	do	November 1939.	9	15,200	10.1	11.6	1.0	76	7.2	9	31	----------
Do	do	December 1939.	10	31,000	5.8	12.3	1.1	77	7.0	9	29	----------
Do	do	January 1940	3	37,300	.8	14.1	1.4	33	6.8	22	29	----------
Do	do	February 1940	4	133,900	2.1	12.8	2.7	30	7.0	110	29	----------
Do	do	March 1940	11	129,500	4.1	12.6	1.7	55	6.8	124	25	----------
Do	do	April 1940	4	273,900	8.0	10.9	1.8	64	6.7	158	17	----------
Hanging Rock Light, above Little Sandy River.	O 330	June 1939	11	41,200	25.6	7.4	1.9	167	7.2	60	31	----------
Do	do	July 1939	9	42,400	26.1	7.2	1.2	289	----------	----------	----------	----------
Do	do	August 1939	12	21,800	26.2	7.4	1.0	151	----------	----------	----------	----------
Do	do	September 1939.	10	8,300	24.4	7.5	.9	230	----------	----------	----------	----------
Do	do	October 1939	11	13,700	18.3	8.9	.9	186	----------	----------	----------	----------
Do	do	November 1939.	9	15,100	9.8	11.5	1.0	67	----------	----------	----------	----------
Do	do	December 1939.	10	29,900	6.1	12.4	1.0	71	7.2	7	32	----------
Do	do	January 1940	3	37,300	.5	14.0	1.1	32	----------	----------	----------	----------

Do	do	February 1940	4	133,900	1.8	12.8	2.6	29	6.7	260	23	
Do	do	March 1940	11	129,500	4.0	12.6	1.5	34				
Do	do	April 1940	4	273,900	8.0	10.8	1.7	34				
Coal Branch Light, below Little Sandy River.	O 337	June 1939	11	41,300	25.6	7.2	2.1	225	7.1	67	32	
Do	do	July 1939	9	43,100	26.1	7.1	1.4	215	7.3	132	38	
Do	do	August 1939	12	21,900	26.1	7.3	1.1	177	7.3	43	33	
Do	do	September 1939.	10	8,300	24.3	7.5	1.0	52	7.4	5	46	
Do	do	October 1939	11	13,800	18.1	8.8	.8	75	7.5	6	40	
Do	do	November 1939.	9	15,200	9.8	11.3	1.0	96	7.2	9	31	
Do	do	December 1939.	10	30,000	5.4	12.3	1.1	54	7.1	9	29	
Do	do	January 1940	3	38,000	.5	13.9	1.0	27	6.8	21	27	
Do	do	February 1940	3	121,000	2.2	13.4	1.8	50				
Do	do	March 1940	10	132,400	4.0	12.4	1.5	40	6.8	75	24	
Do	do	April 1940	4	276,000	7.6	10.7	1.7	35	6.7	155	17	
Lock and dam No. 30	O 339	June 1939	2	41,200	27.1	6.7	1.9	278	7.4	130	32	
Do	do	July 1939	7	43,000	26.9	7.2	1.4	220	7.4	99	36	
Do	do	August 1939	9	21,900	26.8	7.5	1.2	95	7.5	33	33	
Do	do	September 1939.	7	8,300	24.2	7.5	1.1	37	7.5	8	44	
Do	do	October 1939	9	13,800	18.3	8.8	1.1	48	7.6	8	40	
Do	do	November 1939.	9	15,200	9.3	11.2	1.2	28	7.2	9	32	
Do	do	December 1939.	7	30,000	5.5	12.2	1.2	61	7.1	14	29	
Do	do	January 1940	3	39,600	1.6	13.8	1.5	59	6.9	24	29	
Do	do	February 1940	4	132,800	2.0	12.8	2.5	41	7.0	186	30	
Do	do	March 1940	8	147,500	4.3	12.2	1.9	34	6.9	148	25	
Do	do	April 1940	3	258,900	8.4	11.0	1.7	46	6.6	147	18	
Scioto River, Lucasville bridge.	O 356.5 (15.5 miles above mouth of Scioto River).	January 1939	9	5,037	4.7	11.5	2.5	200	7.7		173	
Do	do	February 1939	7	23,343	3.6	11.9	2.6	333	7.6		117	
Do	do	March 1939	9	14,244	7.7	10.5	2.1	129	7.6		145	
Do	do	April 1939	7	12,043	10.9	9.5	1.5	84	7.7		155	
Do	do	May 1939	5	2,858	17.0	8.9	2.4	26	8.0		226	
Do	do	June 1939	9	8,390	24.3	6.5	2.2	63	7.8		184	
Do	do	July 1939	5	3,092	23.7	7.2	1.9	8	7.9		194	
Do	do	September 1939.	5	458	21.7	7.6	3.0	3	8.0	28	222	
Do	do	October 1939	4	349	15.4	8.2	2.7	3	8.0	24	267	
Do	do	November 1939.	5	571	7.2	10.0	1.8	6	7.9	18	229	
Do	do	December 1939.	3	610	6.2	10.2	1.9	2	7.8	10	229	
Do	do	January 1940	1	405	.5	10.4	3.7	9	7.6	7	271	

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Lock and dam No. 31, below Scioto River.	O 359	June 1939	2	47,500	26.1	6.5	2.3	139	7.4	125	42	
Do	do	July 1939	8	45,300	25.9	7.1	1.5	79	7.4	90	49	
Do	do	August 1939	9	22,800	25.5	7.4	1.4	78	7.5	38	43	
Do	do	September 1939.	8	7,900	23.0	7.5	.9	105	7.6	6	60	
Do	do	October 1939	9	13,100	17.4	9.0	1.0	76	7.6	9	52	
Do	do	November 1939.	9	15,700	8.2	11.2	1.6	37	7.1	9	36	
Do	do	December 1939.	8	29,000	5.1	12.1	1.3	40	7.1	14	32	
Do	do	January 1940	2	50,000	.7	13.5	1.7	28	6.9	38	36	
Do	do	February 1940	5	143,800	1.9	12.6	2.9	76	7.1	191	34	
Do	do	March 1940	8	147,400	4.3	12.1	1.9	44	6.9	160	26	
Do	do	April 1940	3	260,800	7.9	11.0	1.8	35	6.6	148	20	
Lock and dam No. 32	O 383	June 1939	2	47,200	26.5	6.4	1.8	138	7.5	80	47	
Do	do	July 1939	7	44,500	25.9	7.1	1.5	56	7.4	90	49	
Do	do	August 1939	9	22,700	26.9	7.3	1.3	37	7.4	41	44	
Do	do	September 1939.	7	7,000	24.2	7.5	1.4	3	7.4	10	56	
Do	do	October 1939	9	12,000	17.8	9.0	1.5	7	7.5	11	55	
Do	do	November 1939.	9	15,500	8.8	11.2	1.4	20	7.1	11	39	
Do	do	December 1939.	8	27,500	7.0	11.9	1.2	50	7.1	14	34	
Do	do	January 1940	1	57,900	.5	13.2	1.8	15	6.7	50	35	
Do	do	February 1940	3	127,800	2.6	12.6	2.6	86	7.0	145	31	
Do	do	March 1930	8	164,900	4.1	11.8	2.1	44	6.9	188	28	
Do	do	April 1940	3	260,300	8.9	10.8	2.4	76	6.6	133	20	
Lock and dam No. 33	O 405	February 1939	3	301,700	5.2	12.1	2.0	106	7.3	165	26	
Do	do	March 1939	4	216,700	7.3	11.5	2.1	53	7.5	213	34	
Do	do	April 1939	3	237,100	9.3	10.8	3.5	37	7.5	107	35	
Do	do	May 1939	3	33,700	16.2	9.8	1.3	16	7.7	23	48	
Do	do	July 1939	2	44,000	25.8	7.5	2.2	60	7.4	112	50	
Do	do	August 1939	5	22,500	26.8	7.4	1.8	27	7.4	66	43	
Do	do	September 1939.	3	6,100	24.3	7.6	1.4	154	7.6	99	55	
Do	do	October 1939	5	11,300	18.4	8.7	1.1	9	7.5	13	58	

Do	do	November 1939.	4	15,800	9.0	11.3	1.4	14	7.3	10	38	
Do	do	December 1939.	3	26,000	7.2	11.9	1.2	29	7.3	11	34	
Do	do	January 1940	1	91,800	0	13.7	.9	9	7.2	8	35	
Do	do	February 1940	2		2.5	12.7	2.4	48	7.2	260	33	
Do	do	March 1940	4	131,800	4.3	12.3	2.2	71	7.2	186	31	
Do	do	April 1940	3	240,300	8.2	11.1	1.9	39	7.1	187	27	
Lock and dam No. 34	O 434	February 1939	6	305,600	4.0	12.0	2.4	97	7.2	257	27	
Do	do	March 1939	11	219,900	5.8	11.4	2.7	41	7.5	231	32	
Do	do	April 1939	9	238,300	8.5	10.5	1.9	86	7.4	172	34	
Do	do	May 1939	9	34,800	17.6	9.5	1.7	10	7.6	21	49	
Do	do	June 1939	4	44,400	25.3	7.7	2.7	45	7.6	68	48	
Do	do	July 1939	3	43,400	25.9	7.0	1.7	100	7.3	179	47	
Do	do	August 1939	5	21,000	25.7	7.2	1.6	117	7.4	113	54	
Do	do	September 1939.	3	6,600	23.7	7.8	.8	1	7.6	11	59	
Do	do	October 1939	5	10,600	16.6	8.8	1.0	5	7.6	19	60	
Do	do	November 1939.	4	15,800	8.3	11.4	1.1	7	7.5	12	42	
Do	do	December 1939.	3	26,000	5.5	11.9	.9	49	7.3	13	27	
Do	do	January 1940	1	32,500	0	13.4	.8	11	7.2	16	36	
Do	do	February 1940	2		2.2	12.4	2.4	52	7.1	245	30	
Do	do	March 1940	4	133,500	4.0	11.9	2.2	56	7.3	241	33	
Do	do	April 1940	3	238,600	7.3	10.9	2.0	59	7.1	200	32	
Lock and dam No. 35	O 451	February 1939	7	307,800	3.8	11.9	2.4	57	7.2	277	27	
Do	do	March 1939	11	221,700	6.1	11.4	2.5	73	7.5	251	32	
Do	do	April 1939	10	239,000	8.9	10.5	2.1	39	7.3	209	35	
Do	do	May 1939	7	35,300	15.4	9.8	1.6	9	7.6	27	48	
Lock and dam No. 36	O 461	February 1939	6	309,100	3.8	12.0	2.8	130	7.3	274	28	
Do	do	March 1939	11	222,900	5.8	11.5	2.2	48	7.4	241	29	
Do	do	April 1939	8	239,500	8.6	10.6	1.8	73	7.2	172	38	
Do	do	May 1939	12	35,700	17.4	9.5	1.6	5	7.6	18	50	
Do	do	June 1939	11	42,400	24.4	7.5	2.0	57	7.7	102	48	
Do	do	July 1939	9	43,400	25.0	7.0	1.7	92	7.2	241	46	
Do	do	August 1939	12	19,400	24.9	7.5	1.6	44	7.5	93	46	
Do	do	September 1939.	9	7,000	23.2	8.1	.9	7	7.7	13	54	
Do	do	October 1939	11	10,500	16.5	9.1	.7	3	7.6	11	63	
Do	do	November 1939.	10	15,800	8.7	11.3	1.1	7	7.4	18	44	
Do	do	December 1939.	10	26,100	5.2	12.2	1.2	55	7.3	20	35	
Do	do	February 1940	5	158,800	1.6	12.5	2.4	133	7.1	237	30	
Do	do	March 1940	10	157,400	3.9	11.8	1.9	45	7.3	256	34	
Do	do	April 1940	6	256,900	7.9	10.6	1.9	32	7.2	192	27	

TABLE OH–7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Stillwater Boat Harbor, above Little Miami River.	O 462.8	April 1939	4	239,600	8.0	11.0	2.1	39				
Do	do	May 1939	4	35,800	22.3	9.4	2.0	2				
Do	do	June 1939	10	42,200	25.3	7.7	2.3	33				
Do	do	July 1939	8	42,800	26.3	7.1	1.9	442				
Do	do	August 1939	12	19,400	26.5	7.8	1.5	38				
Do	do	September 1939.	8	7,100	25.0	8.4	1.1	5				
Do	do	October 1939	11	10,300	18.3	9.3	1.0	5				
Do	do	November 1939.	9	15,800	9.6	12.0	1.4	4				
Do	do	December 1939.	7	26,100	6.1	12.4	1.4	30				
Do	do	April 1940	4		8.5	10.3	2.1	100				
Little Miami River, mouth, Beechmont Bridge.	O 464.1 (4.3 miles above mouth of Little Miami River).	February 1939	2	8,000	2.5	12.5	2.1	240				
Do	do	March 1939	4	2,800	6.6	11.3	1.9	88				
Do	do	April 1939	4	3,100	9.3	10.2	1.8	348				
Do	do	May 1939	5	500	18.4	7.6	2.9	920				
Do	do	June 1939	4	5,000	22.3	6.3	4.3	2,580				
Do	do	July 1939	2	200	21.8	5.7	7.6	4,600				
Do	do	August 1939	2	200	24.5	5.8	4.3	3,300	7.8			
Do	do	September 1939	2	200	19.8	2.3	6.1	2,520	7.5			
Do	do	October 1939	2	80	15.5	3.3	7.9	6,650	7.6			
Do	do	November 1939	2	140	7.0	7.9	11.5	4,450	7.6			
Do	do	December 1939	1	167	3.5	12.0	7.5	1,100	7.9			
Do	do	January 1940	4	269	0	12.3	4.8	2,880	7.7	170		
Do	do	February 1940	4	1,210	2.0	13.3	3.6	394	7.8			
Do	do	March 1940	4	1,390	5.9	12.0	2.0	324	7.7			
Do	do	April 1940	7	881	11.1	(4)	1.8	284	7.7	173	118	
Marmet's Landing	O 465.3	April 1939	4	245,900	8.3	10.9	2.2	146				
Louisville & Nashville R. R. bridge, above Licking River.	O 469.5	April 1939	8	246,700	8.1	11.0	2.0	78				
Do	do	May 1939	9	36,500	22.2	9.1	1.9	51				
Do	do	June 1939	19	43,600	25.1	7.4	2.5	196				
Do	do	July 1939	16	43,800	26.0	7.0	1.8	312				
Do	do	August 1939	23	19,400	26.4	7.5	1.7	499				
Do	do	September 1939	16	7,300	24.8	8.1	1.7	499				

Do	do	October 1939	22	10,500	18.2	9.0	1.6	604				
Do	do	November 1939	16	16,000	9.5	11.9	1.8	226				
Do	do	December 1939	18	26,200	6.1	12.4	1.8	246				
Do	do	April 1940	8		8.7	10.4	1.8	56				
Licking River, 0.8 miles above mouth of Banklick Creek.	O 470.2 (5.5 miles above mouth of Licking River).	June 1939	1	2,630		6.8	2.0	460	7.8	550	94	
Do	do	July 1939	2	14,140	24.0	6.3	2.2	235				
Do	do	August 1939	2	2,020	23.8	6.5	1.6	45	7.5			
Do	do	September 1939	2	80	22.3	6.5	1.4	5	7.8			
Do	do	October 1939	2	60	15.8	8.0	1.5	3	7.8			
Do	do	November 1939	2	190	5.5	11.4	1.1	4	7.6			
Do	do	December 1939	2	128	2.0	12.2	2.0	9	7.6			
Do	do	January 1940	2	3,990	0	13.4	3.7	57	7.6			
Do	do	February 1940	3	10,950	2.8	12.5	3.8	125	7.5			
Do	do	March 1940	5	14,270	7.6	11.2	1.5	27	7.6			
Licking River, Louisville & Nashville bridge near Latonia, Ky.	O 470.2 (3.3 miles above mouth of Licking River).	April 1939	4	11,230	12.9	9.9	1.1	179				
Do	do	May 1939	5	1,380	21.6	8.3	2.0	285				
Do	do	June 1939	2	2,600	23.5	6.4	2.6	285				
Licking River, mouth	O 470.2 (0.2 mile above mouth of Licking River).	February 1939	1	7,370	6.0	11.7	1.6	150				
Do	do	March 1939	4	22,630	9.3	10.6	3.0	167				
Do	do	March 1940	5	14,270	9.2	11.1	1.9	555	7.6			
Southern Ry. bridge below Licking River.	O 472.3	April 1939	4	265,000	8.3	11.0	2.1	56				
Riverside	O 475.2	May 1939	4	38,400	22.6	7.9	2.9	2,530				
Do	do	June 1939	9	45,200	24.8	6.6	3.0	1,850				
Do	do	July 1939	9	50,700	25.8	6.6	2.2	2,270				
Do	do	August 1939	11	20,700	26.3	6.3	2.3	5,140				
Do	do	September 1939	8	7,700	24.9	3.9	2.9	32,600				
Do	do	October 1939	11	10,500	18.4	6.2	2.9	60,800				
Do	do	November 1939	7	16,100	9.5	11.1	3.3	4,300				
Do	do	December 1939	10	26,400	5.9	11.9	3.7	1,490				
Do	do	April 1940	4	277,500	8.7	10.4	2.0	402				
Anderson's Ferry	O 477.5	April 1939	5	265,300	8.2	10.9	2.3	94				
Lock and dam No. 37	O 483	February 1939	8	349,200	3.7	11.8	2.5	67	7.5	333	38	
Do	do	March 1939	12	245,600	5.9	11.3	2.3	132	7.5	325	36	
Do	do	April 1939	10	265,300	9.3	10.4	1.9	281	7.3	194	38	
Do	do	May 1939	10	38,400	18.5	8.8	2.7	1,630	7.7	21	61	
Do	do	June 1939	10	45,200	25.8	6.4	3.4	2,040	7.9	98	59	
Do	do	July 1939	10	50,700	26.7	6.3	2.2	1,960	7.3	240	57	
Do	do	August 1939	11	20,700	26.6	5.4	2.2	5,830	7.5	90	54	
Do	do	September 1939	11	7,700	24.7	3.8	1.9	913	7.4	12	62	
Do	do	October 1939	11	10,500	18.0	5.7	1.7	12,000	7.4	11	67	
Do	do	November 1939	11	16,100	8.9	10.6	2.4	1,700	7.3	17	44	
Do	do	December 1939	10	26,400	5.4	11.4	3.6	1,980	7.2	20	40	
Do	do	February 1940	3	143,900	3.7	12.4	3.1	80	7.2	232	38	
Do	do	March 1940	11	151,100	5.1	11.7	2.6	110	7.3	190	35	
Do	do	April 1940	12	369,200	9.0	10.4	3.9	144	7.1	268	30	

[4] Not run.

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Miami River, mouth, west of Cleves.	O 491.1 (4.2 miles above mouth of Miami River).	March 1939	4	10, 600	6. 4	11. 6	4. 4	265	8. 2	85	244	
Do	do	April 1939	3	4, 400	12. 2	9. 7	2. 9	175	8. 0	40	239	
Do	do	May 1939	4	2, 100	19. 3	9. 4	4. 4	131	8. 1	22	245	
Do	do	June 1939	5	5, 100	24. 9	7. 5	4. 1	325	8. 0	171	213	
Do	do	July 1939	6	4, 300	24. 8	7. 3	4. 1	1, 680	7. 8	809	195	
Do	do	August 1939	7	1, 800	24. 8	8. 0	4. 0	376	8. 1	102	208	
Do	do	September 1939	6	700	21. 8	8. 3	4. 0	41	8. 0	28	227	
Do	do	October 1939	7	600	15. 6	8. 6	4. 5	50	7. 9	16	236	
Do	do	November 1939	6	700	6. 9	9. 6	3. 2	190	7. 7	18	246	
Do	do	December 1939	6	910	5. 8	9. 7	3. 2	90	7. 7	12	250	
Do	do	January 1940	2	2, 560	. 5	12. 7	4. 1	252	7. 7	195	215	
Do	do	February 1940	5	7, 290	2. 8	11. 8	5. 5	243	7. 8	318	171	
Do	do	March 1940	6	9, 630	5. 5	10. 7	3. 9	2, 290	7. 9	153	198	
Do	do	April 1940	4	4, 220	11. 0	9. 2	4. 8	433	7. 9	65	226	
Lock and dam No. 38	O 503.3	February 1939	9	363, 400	3. 6	11. 8	3. 1	438	7. 4	39	308	
Do	do	March 1939	12	262, 100	5. 7	11. 2	2. 6	430	7. 7	325	44	
Do	do	April 1939	10	285, 800	9. 6	10. 3	2. 2	294	7. 3	204	45	
Do	do	May 1939	10	42, 000	19. 3	9. 0	2. 5	924	7. 7	22	70	
Do	do	June 1939	11	54, 400	24. 9	6. 6	2. 6	763	8. 0	113	70	
Do	do	July 1939	10	55, 900	26. 0	6. 1	2. 4	1, 020	7. 4	271	61	
Do	do	August 1939	11	24, 300	26. 0	6. 3	1. 8	338	7. 6	85	67	
Do	do	September 1939	11	8, 400	23. 8	6. 5	2. 1	85	7. 6	13	81	
Do	do	October 1939	11	11, 800	17. 1	6. 5	1. 9	412	7. 5	10	85	
Do	do	November 1939.	11	16, 800	8. 6	10. 2	2. 3	2, 140	7. 3	17	54	
Do	do	December 1939.	10	27, 300	4. 9	11. 3	2. 7	1, 200	7. 2	25	46	
Do	do	February 1940	3	163, 300	2. 6	12. 3	3. 7	156	7. 3	217	47	
Do	do	March 1940	10	165, 800	4. 4	11. 6	2. 3	110	7. 3	202	38	
Do	do	April 1940	5	280, 100	9. 3	10. 2	2. 9	96	7. 2	244	33	
Lock and dam No. 39	O 531.7	February 1939	10	366, 200	4. 2	11. 7	3. 2	96	7. 4	384	39	
Do	do	March 1939	12	267, 300	6. 8	11. 2	3. 3	149	7. 7	368	47	
Do	do	April 1939	10	293, 400	9. 9	10. 3	2. 7	201	7. 3	204	47	
Do	do	May 1939	8	42, 800	17. 7	9. 3	2. 4	218	7. 8	27	72	
Do	do	June 1939	4	56, 300	25. 6	6. 1	2. 6	284	7. 9	98	73	
Do	do	July 1939	4	57, 500	26. 4	6. 2	2. 1	105	7. 2	219	59	
Do	do	August 1939	4	25, 800	26. 8	6. 3	1. 4	201	7. 5	72	61	

Do	do	September 1939.	5	8,100	24.6	8.6	2.4	2	7.8	13	81	
Do	do	October 1939	4	12,400	18.3	8.2	1.9	13	7.6	6	87	
Do	do	November 1939.	5	16,400	9.7	10.5	2.2	573	7.2	18	59	
Do	do	December 1939.	4	27,400	5.0	11.4	2.4	520	7.3	21	45	
Do	do	March 1940	5	142,000	4.8	11.6	2.2	200	7.3	167	44	
Do	do	April 1940	2	300,100	8.0	9.9	2.7	174	7.3	290	32	
Do	do	July 1940	4	36,400	26.9	7.2	2.7	207	7.5	17	53	
Do	do	October 1940	2	13,200	18.0	12.1	3.2	78	8.3	10	57	
Do	do	January 1941	3	75,900	3.7	12.6	3.7	338	7.3	61	50	
Kentucky River, mouth, Carrollton, Ky.	O 545.8 (0.2 mile above mouth of Kentucky River).	March 1939	5	27,600	8.7	11.1	1.5	35	7.9	393	66	
Do	do	April 1939	3	18,800	11.0	11.4	1.4	29	7.6	218	65	
Do	do	May 1939	4	3,900	19.5	9.1	3.0	3	7.9	37	85	
Do	do	June 1939	5	4,500	25.0	7.5	2.0	30	7.8	187	80	
Do	do	July 1939	4	18,800	26.3	7.1	2.6	204	7.3	565	62	
Do	do	August 1939	4	2,900	25.9	6.3	1.6	25	7.5	201	83	
Do	do	September 1939.	5	1,000	25.1	7.4	1.2	4	7.7	13	93	
Do	do	October 1939	4	600	19.1	6.3	1.0	3	7.5	9	102	
Do	do	November 1939.	5	700	10.2	8.9	1.4	5	7.5	15	94	
Do	do	December 1939.	4	800	5.2	10.7	1.4	16	7.5	17	100	
Do	do	February 1940	4	10,000	4.3	12.8	1.4	21	7.6	159	76	
Do	do	March 1940	5	33,900	6.9	11.4	1.5	34	7.5	323	60	
Do	do	April 1940	1	1,200	13.0	10.3	1.4	24	7.3	310	54	
Do	do	July 1940	4	3,500	26.5	7.4	1.8	28	7.5	80	61	
Do	do	October 1940	2	200	17.8	8.5	1.6	57	7.6	14	61	
Do	do	January 1941	3	1,700	5.0	12.3	3.1	20	7.4	73	79	110
Notch Lick Light	O 547.8	July 1940	4	43,900	26.6	7.9	2.2	186	7.5	26	55	
Do	do	October 1940	2	13,800	17.9	11.8	2.9	24	8.5	20	54	
Do	do	January 1941	3	79,600	3.9	12.7	3.5	87	7.3	61	50	
Crooked Creek Upper Light	O 559.5	July 1940	2	35,100	29.0	8.5	2.6	94	7.6	15	54	
Clifty Creek Lower Light	O 561	July 1940	2	40,100	26.1	7.9	2.2	1,260	7.5	29	55	
Do	do	October 1940	2	11,700	19.5	11.2	3.1	58	8.4	18	54	
Do	do	January 1941	3	89,200	3.4	12.5	3.4	199	7.3	54	55	
Lower Hanover Landing	O 562.6	July 1940	2	35,100	29.0	8.3	2.1	218	7.6	15	53	
Do	do	October 1940	2	11,700	19.4	11.4	2.7	17	8.5	10	51	
Do	do	January 1941	3	89,200	3.3	12.5	3.5	60	7.3	59	55	
Jobson Landing	O 576.1	July 1940	4	37,600	27.3	8.3	2.2	113	7.5	13	54	
Do	do	October 1940	2	11,700	18.7	10.1	2.9	3	8.0	11	49	
Do	do	January 1941	3	89,200	3.1	12.6	3.2	108	7.3	59	55	
Six Mile Island Light	O 597.9	August 1940	1	36,200	29.5	9.4	2.8	9	8.1	12	52	
Louisville waterworks	O 600.0	August 1940	3	26,900	29.0	8.8	2.2	44	8.1	9	55	
Do	do	Jan. 31–Feb. 5, 1941.	5	128,100	2.6	12.6	1.6	143	7.2	95	50	

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Louisville highway bridge	O 602.5	August 1940	1	36, 200	29.5	9.0	2.4	930	8.1	12	53	
New Albany waterworks	O 608.5	August 1940	4	25, 300	28.4	8.2	2.6	997	8.0	13	53	
Do	do	October 1940	2	13, 300	17.8	7.3	1.6	695	7.6	8	54	
Do	do	February 1941	3	101, 200	2.0	13.1	1.7	142	7.2	74	46	
Falling Run Light	O 610	August 1940	4	25, 300	28.8	8.2	2.3	3, 220	8.1	11	57	
Do	do	October 1940	2	13, 300	17.9	7.3	2.3	765	7.5	8	53	
Do	do	February 1941	3	101, 200	2.1	13.0	1.8	258	7.2	71	46	
Hughes Bar Upper Light	O 614	August 1940	4	25, 300	28.3	8.1	2.6	3, 480	8.0	10	56	
Do	do	October 1940	2	13, 300	17.5	7.2	2.4	765	7.5	9	52	
Do	do	February 1941	3	101, 200	2.1	13.1	4.2	87	7.2	74	45	
Kosmosdale, Ky	O 627.1	August 1940	4	23, 300	28.8	8.6	2.3	105	8.2	10	57	
Steve Green Landing Light	O 627.9	October 1940	5	11, 500	16.2	7.9	2.0	376	7.5	6	50	
Do	do	February 1941	5	66, 100	1.2	12.9	2.5	141	7.3	47	55	
Salt River, mouth	O 629.9 (0.1 mile above mouth of Salt River).	August 1940	3	246	27.7	3.5	2.0	845	7.5	60	123	124
Do	do	October 1940	5	230	15.8	8.3	2.1	27	7.5	17	67	114
Do	do	February 1941	5	753	2.2	12.7	1.1	32	7.8	14	170	186
Lock and dam No. 43	O 633.2	August 1940	4	23, 400	28.6	8.6	2.6	740	8.2	11	59	
Do	do	October 1940	5	11, 200	16.5	8.4	2.1	107	7.6	6	50	
Do	do	February 1941	5	67, 700	1.6	13.0	3.2	153	7.3	45	53	
Rock Haven Upper Light	O 637.1	October 1940	5	11, 200	16.8	None	None	63	7.6		51	116
Do	do	February 1941	5	67, 700	1.6	12.8	2.4	195	7.3	45	55	
Falling Spring Lower Light	O 639.1	October 1940	5	11, 200	16.6	None	None	67	7.6		50	
Do	do	February 1941	5	67, 700	1.6	12.9	1.6	246	7.3	44	52	
Lock and dam No. 44	O 662	August 1940	4	67, 200	26.5	7.5	2.7	63	7.8	30	56	
Do	do	February 1941	2	44, 500	3.9	13.0	1.8	23	7.2	30	60	
Indian Hollow Light	O 665	August 1940	4	67, 200	27.2	7.5	2.4	73	7.9	32	56	
Do	do	February 1941	2	44, 500	3.7	13.3	1.7	96	7.3	30	60	
Lock and dam No. 45	O 703	August 1940	4	64, 700	27.2	7.3	2.3	90	7.9	30	60	
Do	do	February 1941	2	42, 800	3.7	13.1	1.5	16	7.3	30	55	
Cloverport Light	O 711.3	August 1940	2	67, 300	26.8	7.0	2.1	78	7.6	33	54	
Do	do	February 1941	3	49, 900	2.1	13.1	2.6	65	7.3	33	58	
Hancock Bend Lower Light	O 722.7	August 1940	2	80, 100	27.0	6.8	2.0	78	7.6	31	55	
Do	do	February 1941	3	45, 600	2.1	13.1	3.0	14	7.3	33	58	
Troy Hill Light	O 730.6	August 1940	4	58, 800	27.8	6.8	2.2	51	7.8	34	60	
Do	do	February 1941	3	45, 600	2.2	13.1	3.3	96	7.3	36	57	
Owensboro water works intake.	O 756.5	Aug. 26 Sept. 5, 1940.	5	56, 200	25.7	8.1	2.0	37	7.9	28	53	
Do	do	October 1940	2	10, 400	16.7	9.8	2.6	4	8.1	10	61	
Do	do	February 1941	2	71, 500	1.0	13.1	3.6	29	7.3	30	64	

Lock and dam No. 46	O 757	August 1940	1	18,100	27.2	9.4	2.2	4	8.4	10	57	
Larkin Ferry Light	O 760	Aug. 26-Sept. 5, 1940.	5	56,200	25.7	8.1	2.1	35	7.9	29	53	
Do	do	October 1940	2	10,400	16.7	9.6	2.2	97	8.0	9	60	
Do	do	February 1941	2	71,500	.5	13.4	1.1	16	7.3	32	63	
Lock and dam No. 47	O 777.7	Aug. 26-Sept. 5, 1940.	5	55,400	25.8	8.4	1.9	66	8.0	29	55	
Do	do	October 1940	2	9,700	16.8	8.9	2.0	16	8.0	11	63	
Do	do	February 1941	2	70,600	1.1	13.4	1.2	17	7.3	33	60	
Green River, Spottsville Bridge.	O 784.2 (8.6 miles above mouth of Green River).	Aug. 28-Sept. 4, 1940	3	1,097	26.7	7.0	1.4	1	7.7	18	104	102
Do	do	October 1940	2	667	17.5	8.3	.5	1	7.8	13	126	125
Do	do	February 1941	2	3,250	4.0	12.5	.8	2	7.6	58	91	122
Evansville water works intake.	O 791	Aug. 27-Sept. 5, 1940.	5	57,100	25.9	8.3	2.1	22	8.0	28	57	
Do	do	October-November 1940.	2	15,800	17.7	9.2	2.1	24	8.0	12	64	
Do	do	February 1941	2	71,100	.8	13.4	1.7	16	7.4	33	65	
Dutch Bend Light	O 797.7	Aug. 27-Sept. 6, 1940.	4	62,100	26.5	8.3	1.7	106	7.9	32	55	
Do	do	Oct. 29-Nov. 1, 1940.	2	14,200	17.5	9.1	2.4	350	8.1	13	64	
Do	do	February 1941	2	48,700	.8	13.4	1.3	9	7.4	29	72	
Henderson water works intake.	O 803	Aug. 27-Sept. 6, 1940.	4	62,100	26.5	8.2	1.7	199	7.9	35	56	
Do	do	Oct. 29-Nov. 1, 1940.	2	14,200	17.7	9.4	2.8	142	8.2	12	64	
Do	do	February 1941	2	48,700	.8	13.4	1.1	9	7.4	29	70	
Lock and dam No. 48	O 809	Aug. 27-Sept. 6, 1940.	4	62,100	26.4	8.3	1.9	356	7.9	36	56	
Do	do	Oct. 29-Nov. 1, 1940.	2	14,200	17.6	9.5	2.3	58	8.2	13	66	
Do	do	February 1941	2	48,700	.8	13.3	1.1	24	7.4	26	70	
Mount Vernon water works	O 829.1	September 1940.	4	19,700	23.2	9.0	2.1	19	7.9	18	53	
Do	do	November 1940.	2	47,000	15.3	9.8	2.2	142	7.8	13	61	
Do	do	February 1941	2	31,400	2.3	13.6	3.7	6	7.5	19	78	
Lock and dam No. 49	O 845	September 1940.	4	19,700	24.0	9.1	1.7	29	7.9	15	54	
Do	do	November 1940.	2	47,000	15.3	9.6	2.2	78	7.8	13	60	
Do	do	February 1941	2	31,400	2.1	13.6	2.7	28	7.4	16	82	
Wabash River, mouth	O 848.0 (0.1 mile above mouth of Wabash River).	September 1940.	4	3,000	22.4	8.4	2.5	2	8.3	55	198	170
Do	do	November 1940.	2	3,010	14.0	10.1	2.7	4	8.3	19	213	150
Do	do	February 1941	2	6,080	2.0	14.2	3.3	1	8.1	16	202	196

TABLE OH-7.—*Main Ohio River: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from Pittsburgh	Period	Number of samples	Average discharge, cubic feet per second	Temperature ° C	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms most probable number, per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness parts per million
Browns Light	O 852.3	September 1940.	4	19,700	24.1	9.2	2.0	19	8.0	17	72	
Do	do	November 1940.	2	50,000	15.8	9.7	2.4	20	7.7	14	63	
Do	do	February 1941	2	38,700	2.0	13.9	2.8	8	7.6	16	89	
Greens Crossing, Upper Light.	O 864.8	September 1940.	4	26,700	23.3	9.2	2.0	11	8.0	14	76	
Do	do	November 1940.	3	46,400	15.0	9.9	2.0	26	7.8	13	68	
Do	do	February 1941	2	37,600	1.8	13.1	3.4	5	7.6	16	102	
DeKoven Light	O 870.7	September 1940.	4	23,700	23.3	9.3	1.5	5	8.1	14	71	
Do	do	November 1940.	3	46,800	14.9	9.8	1.9	19	7.8	14	64	
Do	do	February 1941	2	38,100	1.8	13.9	2.7	6	7.6	14	92	
Lock and dam No. 50	O 876.8	September 1940.	4	23,800	23.1	9.2	1.6	3	8.1	14	67	
Do	do	November 1940.	3	47,000	14.8	10.0	2.0	9	7.8	13	64	
Do	do	February 1941	2	37,600	1.8	13.8	2.8	5	7.6	14	86	
Rosiclaire	O 891.6	Sept. 20–Oct. 1, 1940.	4	27,700	21.2	9.2	2.0	62	8.3	12	76	
Do	do	November 1940.	2	38,900	8.8	13.2	3.4	5	8.3	19	76	
Do	do	March 1941	3		2.8	13.8	2.1	2	7.6	17	86	
Golconda water works	O 902.5	Sept. 20–Oct. 1, 1940.	4	27,700	21.5	9.3	1.8	4	8.3	11	72	
Do	do	November 1940.	2	38,900	8.3	13.4	3.4	3	8.3	19	75	
Do	do	March 1941	3		2.7	13.8	2.7	1	7.6	18	88	
Old Maids Crossing Light	O 918	Sept. 20–Oct. 1, 1940.	4	28,400	21.1	9.3	1.8	3	8.3	12	72	
Do	do	November 1940.	2	41,200	8.8	13.0	3.3	1	8.2	19	74	
Do	do	March 1941	3		3.1	13.8	2.2	1	7.6	19	88	
Cumberland River, above mouth.	O 920.4 (2.8 miles above mouth of Cumberland River).*	Sept. 20–Oct. 1, 1940.	4	1,530	21.8	7.8	1.5	2	7.8	24	78	82
Do	do	November 1940.	4	2,650	8.9	9.9	1.2	5	7.4	32	89	96
Do	do	March 1941	3	7,197	5.7	13.0	1.5	2	7.6	22	86	112

Ledbetter Light	O 927.3	Sept. 20–Oct. 1, 1940.	4	30,400	21.7	9.3	1.8	2	8.3	12	77	
Do	do	November 1940.	2	45,900	8.9	13.0	3.2	1	8.2	18	77	
Do	do	March 1941	3		3.2	13.7	2.1	1	7.6	18	89	
Paducah water works	O 934.3	September 1940.	4	28,000	22.4	8.5	1.6	4	7.9	14	66	
Do	do	November 1940.	2	41,800	11.0	11.7	5.1	3	7.8	24	62	
Do	do	March 1941	3		6.3	13.1	2.1	3	7.6	41	74	
Tennessee River, Norton's Bluff Bridge.	O 934.5 (5.3 miles above mouth of Tennessee River).	Sept. 21–Oct. 1, 1940.	4		22.3	8.2	.8	1	7.7	10	59	72
Do	do	November 1940.	4		8.9	10.2	.7	4	7.2	37	51	54
Do	do	March 1941	3		6.5	13.1	1.6	1	7.7	36	65	86
Lock and dam No. 52	O 938.9	September 1940.	4	54,600	22.6	8.6	1.2	5	7.9	12	68	
Do	do	November 1940.	2	74,500	10.7	12.0	1.9	5	7.9	24	65	
Do	do	March 1941	3		4.8	13.4	2.1	1	7.6	28	82	
Lock and dam No. 53	O 962.6	September 1940.	4	54,600	22.6	8.7	1.6	37	8.0	16	69	
Do	do	November 1940.	2	74,500	10.1	12.8	2.1	7	8.0	25	69	
Do	do	March 1941	3		4.6	13.6	2.0	4	7.7	27	83	
Cairo water works intake	O 978	October 1940	3	52,400	19.8	9.4	1.7	11	8.0	12	74	
Do	do	November 1940.	2	86,700	9.3	11.6	2.5	6	7.7	73	70	
Do	do	March 1941	2		5.0	12.8	2.4	7	7.6	48	74	
Cairo Point	O 981	October 1940	3	52,400	19.6	8.9	1.7	89	7.9	92	91	
Do	do	November 1940.	2	86,700	8.3	11.4	2.7	45	7.7	678	117	
Do	do	March 1941	2		4.2	12.6	2.4	102	7.6	95	100	
Mississippi River, Cairo highway bridge.		October 1940	3		18.6	8.0	2.1	434	7.9	343	163	
Do		November 1940.	2		6.8	10.9	3.5	142	7.7	1,280	163	143
Do		March 1941	2		3.8	11.8	3.8	262	7.7	172	146	146
Mississippi River below mouth of Ohio River, Wickliffe, Ky.		October 1940	3		19.2	8.9	1.4	48	7.9	157	104	
Do		November 1940.	2		9.3	11.4	2.6	13	7.7	258	85	120
Do		March 1941	2		4.6	12.8	2.0	54	7.7	82	86	

TABLE OH–7A.—*Main Ohio River: Laboratory data—acid stream results*

Sampling point	Month, 1940	Number samples	pH	Acidity, parts per million			Iron, parts per million	
				Methyl red	Phenolphthalein		Ferrous	Total
					Hot	Cold		
Emsworth Dam, mile 6	September	1	5.4	1	12	7		0.4
	October	11	5.6	3.5(2)		11		.9
	November	9	6.2	5 (1)		12(2)		3.0
Dashield Dam, mile 13.5	September	1	4.7	10	23	17		.4
	October	11	5.6	3 (1)	11(1)	10		1.2(4)
	November	9	6.2		12(2)			
Montgomery Dam, mile 31.7	September	2	4.7(1)	6 (1)	18(1)	13(1)		.3
	October	11	5.4(7)	4.5(2)	17(2)	9(7)		3.2(4)
	November	9	5.9(1)			12(1)		1.0(1)
Dam No. 7, mile 36.5	September	2	4.8(1)	7 (1)	18(1)	15(1)		.4
	October	11	5.4(7)	6 (2)	18(2)	11(7)		.7
	November	9	5.7(2)			10(2)		5.0
Dam No. 8, mile 46.4	October	12	5.4(6)	4.2(3)	18(2)	11(6)	0.6(1)	1.5
	November	9	5.7(2)			10(2)		3.0
Dam No. 9, mile 56.1	October	12	5.1	5.3(3)	16(2)	9(6)		1.3
	November	9	5.7(2)			10(2)		
Dam No. 10, mile 66	October	12	5.9(7)	4.0(5)	14(2)	10(7)	.2(1)	.7(6)
	November	10	4.9(2)	4.5(2)		14(2)		
Dam No. 11, mile 77	October	12	5.0(9)	6.3(6)	17(3)	13(9)		2.2(6)
	November	10	5.0(2)	5.0(1)		14(2)		
Dam No. 12, mile 87.5	October	12	5.0(9)	3.4(7)	20(2)	12(9)	.4(1)	3.0
	November	10	5.3(2)	3.0(1)	(2)	11(2)		
Dam No. 13, mile 96	October	12	5.0(9)	4.3(7)	13(2)	12(9)	.5(2)	2.0
	November	10	5.5(2)			10(2)		2.8(2)
Dam No. 14, mile 114	August	11	4.6(9)	7 (9)	12(6)	12(9)		.2
	September	5	4.6	4	12	10		.3
Dam No. 15, mile 129	August	11	4.8(7)	2 (4)	12(7)	7(7)		.4
	September	5	4.7	4	13	9		.4
Dam No. 16, mile 146.5	August	11	5.0	3 (3)	10(6)	7(6)		.7
	September	5	4.8	3 (4)	12	8		.2
Dam No. 17, mile 167.5	August	11	5.5	2 (1)	10	8		.2
	September	5	4.9(4)	3 (3)	10(4)	7(4)		.3

NOTE.—Figures in parentheses indicate number acid samples used in computing averages as shown.

MINOR TRIBUTARY BASINS

CONTENTS

	Page
Contents	259
Syllabus and conclusions	261
Description	262
Presentation of field data	263
Presentation of laboratory data	266
Hydrometric data	268
Discussion	268

LIST OF TABLES

M–1.—Cost estimates of remedial measures	262
M–2.—Surface water supplies	264
M–3.—Sources of pollution	265
M–4.—Industrial wastes	265
M–5.—Selected laboratory data	267
M–6.—Monthly mean summer flows	268
M–7.—Summary of laboratory results	270
M–7a.—Summary of laboratory results on acid streams	299

LIST OF FIGURES

(NOTE.—For maps of minor tributary basins see main Ohio River summary.)

MINOR TRIBUTARY BASINS [1]

Syllabus and Conclusions

SYLLABUS

Minor tributaries of the Ohio drain 23,780 square miles (about one-ninth of the entire Ohio Basin) in the 6 States bordering the main stream. Less than 10 percent of the 1,400,000 population in the area are in urban communities. Agriculture is the predominant occupation. Coal mining is important in the upper portion of the basin above Marietta, Ohio, and the Saline and Tradewater Basins in Illinois and Kentucky.

Most of the larger communities have sewage-treatment plants and there is little organic industrial waste. Acid mine drainage causes the most serious pollution. (See separate section of report on acid mine drainage.)

CONCLUSIONS

(1) Forty-four of the ninety-four public water supplies in the area drained by minor tributaries of the Ohio River are from surface sources. Nine of these, serving 24,600 people, are from streams subject to pollution.

(2) Sewage from 173,500 people and industrial wastes equivalent in oxygen demand to sewage from an additional 31,200 people are discharged to minor tributaries of the Ohio. About two-thirds of the sewage receives treatment.

(3) Laboratory data indicate many instances of heavy local pollution, particularly on very small streams. At the time of sampling the streams generally were in good sanitary condition at their confluence with the Ohio River except where they were influenced by wastes from Ohio River communities. Many of the tributaries in the upper part of the basin, and several small streams in the Saline and Tradewater Basins, were found to be heavily polluted by acid mine drainage.

(4) Abatement of pollution due to sewage and organic industrial wastes will require secondary treatment in most instances because the receiving streams are generally small and subject to extremely low flows.

(5) Reduction in acidity in the minor tributaries can best be accomplished in connection with a program of mine sealing covering the entire Ohio Basin.[2]

(6) One of the proposed tributary reservoirs authorized by the Congress and studied by the United States Engineer Department

[1] For maps of this area, see main Ohio River.
[2] See section of report on acid mine drainage.

for Ohio River flood control is on a minor tributary. Low-flow regulation by this reservoir would have no appreciable tangible value for pollution abatement.

(7) The following cost estimates of measures for abatement of pollution due to sewage and industrial wastes are summarized from table M-1:

Treatment	Capital cost	Annual charges
Existing	$3,800,000	$330,000
Suggested additional	2,590,000	285,000

Estimated additional costs over existing charges of programs involving uniform treatment throughout the basin area:

Treatment	Capital cost	Annual charges
Primary, all places	$2,220,000	$250,000
Secondary, all places	3,010,000	335,000

TABLE M-1.—*Minor tributary basins: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	12	30	110,300	$3,800,000	$225,000	$105,000	$330,000
Suggested minimum correction:							
Sewage treatment plants	17	23	96,400	1,420,000	100,000	70,000	170,000
Required interceptors				890,000	40,000		40,000
Independent industrial waste correction				280,000	35,000	40,000	75,000
Total				2,590,000	175,000	110,000	285,000
Comparative cost:							
Primary treatment all waste				2,220,000	160,000	90,000	250,000
Secondary treatment all waste				3,010,000	210,000	125,000	335,000
As suggested				2,590,000	175,000	110,000	285,000

DESCRIPTION

Small tributaries of the Ohio River not considered in separate sections of this report drain a total of about 23,780 square miles (slightly less than 12 percent of the entire basin) in the six States which border the Ohio River. The area drained in each State and the drainage areas of some of the larger streams are shown below:

State	Area (square miles)	State	Area (square miles)
Illinois	2,880	Ohio	6,450
Indiana	3,480	Pennsylvania	1,290
Kentucky	6,675	West Virginia	3,005

Tributary	Right or left bank	Miles above mouth of Ohio River	Drainage area (square miles)
Cache River	Right	6.3	720
Tradewater River	Left	107.6	995
Saline River	Right	113.7	1,235
Blue River	do	318.1	466
Brush Creek	do	593.0	435
Little Sandy River	Left	644.6	780
Twelvepole Creek	do	667.7	441
Raccoon Creek	Right	704.9	684
Middle Island Creek	Left	827.0	685
Little Beaver River	Right	941.5	510

Most of the area drained by the minor tributaries of the Ohio is hilly. Portions of the area in Illinois and Indiana are less rugged and better suited to agriculture than the land farther east.

The following tabulation of population of some of the larger communities and of the entire area, shows the relatively sparse population and the lack of urbanization. There are only 16 urban communities in the 23,780 square miles and most of these are in the upper part of the basin. The larger communities are in coal-producing sections.

	Population			
	1910	1920	1930	1940
Larger cities:				
Washington, Pa	18,778	21,480	24,545	26,166
Canonsburg, Pa	3,891	10,632	12,558	12,599
Salem, Ohio	8,943	10,305	10,622	12,301
Harrisburg, Ill	5,309	7,125	11,625	11,453
Wellston, Ohio	6,875	6,687	5,319	5,537
East Palestine, Ohio	3,537	5,750	5,215	5,123
Barnesville, Ohio	4,233	4,863	4,602	5,002
Entire basin:				
Urban	79,125	109,613	116,468	130,344
Rural	1,148,878	1,123,996	1,144,622	1,254,858
Total	1,228,003	1,233,609	1,261,090	1,385,202

Agriculture is the predominant occupation in the area as a whole but there are also important coal-mining areas in Pennsylvania, the panhandle of West Virginia and adjacent parts of Ohio in the upper portion of the basin and in the Saline and Tradewater River Basins in the lower portion of the basin.

Water uses.—None of the minor tributaries have been developed for navigation. There are no hydroelectric developments. Many of the streams, particularly the less polluted ones which are readily accessible to residents of the larger Ohio River cities, are used extensively for recreation.

Presentation of Field Data

Figures Oh–1, Oh–2, and Oh–3 show the location and magnitude of the more important sources of pollution along minor tributaries in the upper, middle, and lower thirds of the Ohio River, respectively.

Public water supplies.—Ninety-four communities and sizable institutions on minor tributaries of the Ohio have water supply systems which serve about 213,700 people. Forty-four of the supplies are

from surface sources of which 9 are from streams subject to sewage pollution above the water intake. The remaining 35 supplies are from streams draining unsewered areas. Table M–2 shows data on the 9 surface water supplies which are most subject to pollution.

TABLE M–2.—*Minor tributary basins: Surface water supplies*

Supply	State	Source	Mileage (1)	Mileage (2)	Treatment (3)	Population served	Consumption, millions of gallons per day
	Supplies below community sewer outfalls						
Sturgis	Kentucky	Tradewater River	7	108	LD	3,100	0.06
Providence	do	do	41	108	FD	4,300	.25
Harrisburg	Illinois	Middle Fork Saline River	35	114	FD	8,000	.53
Versailles	Indiana	Laughery Creek	34	482	FD	500	.02
Osgood	do	Laughery Creek, wells	37	482	FD	1,000	.08
Georgetown	Ohio	Whiteoak Creek	8	557	LD	1,500	.04
Wellston	do	Little Raccoon Creek, impounded.	55	705	FD	4,700	.30
Middlebourne	West Virginia	Middle Island Creek	37	827	FD	600	.04
Bethany	do	Buffalo Creek	13	906	FD	900	.07
Total, below sewer outfalls						24,600	1.39
35 other surface supplies						108,000	8.06
Total surface water supplies						132,600	9.45

[1] Miles above confluence of minor tributary with Ohio River.
[2] Miles from mouth of Ohio River to mouth of minor tributary.
[3] F=coagulated, settled, filtered; L=lime-soda softened; D=chlorinated.

Sewerage.—Table M–3 shows the sewered population and the total waste load at the larger sources of pollution on minor tributaries of the Ohio River. Sewage from 167,800 people enters the streams, about two-thirds of which is treated in 12 primary and 30 secondary treatment plants. Most of the larger sources of pollution are in the upper part of the area. Minor tributaries entering the Ohio above Huntington drain about one-third of the area but they receive about two-thirds of all the sewage.

TABLE M–3.—*Minor tributary basins: Sources of pollution including industrial wastes expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	State	Receiving stream	Mileage (1)	Mileage (2)	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand): Untreated	Sewered population equivalent (biochemical oxygen demand): Discharged
Mounds	Illinois	Trinity Slough	3	7	2,000	None	2,000	2,000
Providence	Kentucky	Owens Creek	43	108	3,800	Chemical	3,800	1,900
Dawson Springs	do	Tradewater River	87	108	1,300	None	1,300	1,300
Harrisburg	Illinois	Pankey Branch	35	114	8,000	Secondary	8,000	1,200
Eldorado	do	Eldorado Ditch	39	114	3,000	None [3]	3,000	3,000
Morganfield	Kentucky	Lost Creek	11	138	2,000	do	2,000	2,000
Fort Branch	Indiana	Pigeon Creek	44	188	100	do	11,100	11,100
Boonville	do	Cypress Creek	13	205	3,000	do	3,000	3,000
Marengo	do	Whiskey Run	27	318	100	do	9,800	9,800
Central Barren	do	Sinkhole	28	323		do	4,000	4,000
Sunman	do	North Hogan Creek	22	484		do	3,600	3,600
Olive Hill	Kentucky	Tygart Creek	52	628	1,000	do	1,000	1,000

[1] Miles above confluence of minor tributary with Ohio River.
[2] Miles above mouth of Ohio River to mouth of minor tributary.
[3] Septic tank ineffective.

TABLE M-3.—*Minor tributary basins: Sources of pollution including industrial wastes expressed as sewered population equivalent (biochemical oxygen demand)*—Continued

Municipality	State	Receiving stream	Mileage	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Wellston	Ohio	Meadow Run	55 705	2,000	Primary	2,300	1,600
Caldwell	do	Duck Creek	39 810	1,000	None	1,000	1,000
West Union	West Virginia	Middle Island Creek	71 827	1,000	do	1,000	1,000
Woodsfield	Ohio	Standing Stone Run	21 863	2,200	Primary	2,200	1,400
Cameron	West Virginia	Grave Creek	18 879	1,600	None	1,600	1,600
Avella	Pennsylvania	Cross Creek	14 909	1,000	do	1,000	1,000
Salineville	Ohio	Riley Run	12 931	1,500	do	1,500	1,500
Lisbon	do	Middle Fork Little Beaver.	24 942	3,400	do	3,400	3,400
Salem	do	do	48 942	12,000	Secondary	12,000	1,800
Burgettstown	Pennsylvania	Raccoon Creek	32 951	1,000	None	1,000	1,000
Oakdale	do	Robinson Run	15 978	1,600	do	1,600	1,600
McDonald	do	do	18 978	3,100	do	3,100	3,100
Bridgeville	do	Chartiers Creek	9 978	4,200	do	4,200	4,200
Canonsburg	do	do	25 978	13,000	do	13,000	13,000
Houston	do	do	26 978	1,600	do	1,600	1,600
Washington	do	do	35 978	28,000	Secondary	28,000	4,200
65 smaller sources				65,300	[4]	67,900	24,000
Total:							
Illinois				20,900		20,900	8,300
Indiana				13,100		43,700	36,300
Kentucky				20,500		20,500	10,700
Ohio				47,300		47,800	17,000
Pennsylvania				58,200		58,200	30,900
West Virginia				7,800		7,900	7,700
Total, all minor tributaries				167,800		199,000	110,900

[4] 9 places, primary treatment; 28 places, secondary treatment; remaining 28 places, no treatment.

Industrial wastes.—Relatively little organic industrial waste enters the minor tributaries. Table M-4 shows the industrial wastes to be equivalent in oxygen demand to sewage from 31,200 people, almost all of which comes from canneries and meat-packing plants. Most of these are located on small streams in Indiana.

TABLE M-4.—*Minor tributary basins: Summary of industrial wastes not discharged to municipal treatment plants with total industrial waste load in the basin*

Industry	Number of plants	Industrial-waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Canning	6		6	5	13,300
Meat	7		7	7	16,700
Milk	2		2	1	300
Steel	4		4	2	
Miscellaneous	5	1	4	1	
Wastes unconnected municipal treatment	24	1	23	16	30,300
Wastes discharged to municipal treatment					900
Total industrial waste load, minor tributaries					31,200

Acid mine drainage.—Probably the most damaging pollution to which the minor tributaries of the Ohio are subjected is from acid mine drainage which affects streams in the upper part of the basin, particularly above Marietta, Ohio, and in the lower part of the basin where the Saline and Tradewater Rivers are the largest acid streams. The total acid load in the entire area before mine sealing is estimated at about 230,000 tons per year. Some 53,000 tons have been removed by sealing. More than 80 percent of the acid is from the area above Huntington. This problem is discussed in a section of the report on acid mine drainage.

Presentation of Laboratory Data

The maps which show coliform, dissolved oxygen, and biochemical oxygen demand results on the main Ohio River also show similar data on its minor tributaries. Summaries of laboratory results are shown on table M–7 (p. 270). Sampling of these areas was done concurrently with work on the adjacent sections of the Ohio River but was generally less intensive than on the main stream or the larger tributaries.

PITTSBURGH TO HUNTINGTON

In general, coliform counts were high along the minor tributaries in this section. A number of the streams were heavily acid. Acid data are summarized in table M–7A. Oxygen conditions were generally rather good except on Chartiers Creek below Washington and Canonsburg, Pa., and on some of the very small tributaries.

HUNTINGTON TO CINCINNATI

None of the minor tributaries on this section were found to be heavily polluted although a number of them showed moderately high coliform counts below some of the small sources of pollution. Oxygen results were good, with biochemical oxygen demands generally below 3 parts per million and dissolved oxygen over 6.5 parts per million.

CINCINNATI TO LOUISVILLE

The tributaries in this section also were found to be in generally good condition. Local pollution was evidenced on Laughery Creek at Batesville, Ind., Hogan Creek at Aurora, Ind., Harrods Creek at La Grange, Ky., and Goose Creek at Anchorage, Ky.

LOUISVILLE TO MOUTH

This section includes the two largest of the Ohio River's minor tributaries, the Saline and Tradewater Rivers which enter the main stream about 110 miles above its mouth. Several of the tributaries of the Saline were found to be acid. Low dissolved oxygen, high biochemical oxygen demands, and high coliform counts were found below Eldorado and Harrisburg, Ill. In the Tradewater Basin local pollution was found at Dawson Springs, Sturgis, and Providence, Ky., and acid was found at Earlington and Providence. Both the Tradewater and Saline were in good sanitary condition at their

mouths during the sampling period. Acid results on these streams are summarized below:

Station	Month 1940	Number of samples	pH	Average acidity, parts per million: Methyl red	Average acidity, parts per million: Phenolphthalein, Hot	Average acidity, parts per million: Phenolphthalein, Cold	Average iron, parts per million: Ferrous	Average iron, parts per million: Total
Saline River:								
Eldorado	August	1	2.8	1,228	2,505	2,404	500	750
Wasson	do	3	4.2	405	940	536	[1] 8	[1] 50
Harrisburg	do	3	3.1	548	1,340	774	[2] 6	[2] 145
Pankey Fork	do	3	4.3	103	445	202	[2] 12	[2] 103
Tradewater River:								
Earlington	November	3	3.3	241	1,024	891	456	475
Providence	October	1	3.6	98	169	157	2	12
Do	November	1	5.7	----------	76	64	5	10

[1] 1 sample only. [2] Average 2 samples only.

Other places where more or less heavy pollution was found were on Cypress Creek below Boonville, Ind., Indian Creek below Corydon, Ind., Beargrass Creek at Louisville, Ky., Lost Creek below Morganfield, Ky., and Crooked Creek below Marion, Ky.

TABLE M-5.—*Minor tributary basins; selected laboratory data*

River	Chartiers Creek	Chartiers Creek	Chartiers Creek	Middle Fork Little Beaver	Middle Fork Short Creek	North Fork Cedar Creek	Goose Creek
Location	Below Washington, Pa.	Below Canonsburg, Pa.	Above Carnegie, Pa.	Below Salem, Ohio	Below Cadiz, Ohio	Below Kentucky State prison	Below Anchorage, Ky.
River miles above—							
Confluence with Ohio	34	23	8.5	37	25	9	4
Mouth of Ohio [1]	978	978	978	942	900	385	384
Period, 1940	October	October	October	June–July	October	July–August	July–August
Number of samples	3	3	4	3	2	3	3
Flow in cubic feet per second:							
Sampling days	----------	----------	----------	1	----------	----------	(2)
Minimum month	----------	----------	24	----------	----------	----------	----------
Water temperature °C	14.7	14.3	11.0	21.5	10.0	27.8	24.2
Coliforms per milliliter	4,800	587	6	102	5,960	9,510	114,000
Dissolved oxygen, parts per million	0.5	1.6	5.3	5.8	5.4	1.9	.0
Biochemical oxygen demand, 5-day, parts per million	15.9	8.3	8.0	2.6	9.3	28.2	52.0

River	Beargrass Creek	Indian Creek	Cypress Creek	Lost Creek	Drainage ditch	Pankey Fork	Crooked Creek
Location	Near mouth	Below Corydon, Ind.	Below Boonville, Ind.	Below Morganfield, Ky.	Below Eldorado, Ill.	Below Harrisburg, Ill.	Below Marion, Ky.
River miles above—							
Confluence with Ohio	0.1	16	1	7	38	34	10
Mouth of Ohio	379	323	205	138	114	114	103
Period, 1940	October	August	October	October–November	August	August	October–November
Number of samples	2	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	----------	----------	----------	1	1	1	(2)
Water temperature °C	17.5	26.5	14.8	13.7	32.5	26.2	16.2
Coliforms per milliliter	46,000	23,800	11,200	4,730	15,600	16	3,000
Dissolved oxygen parts per million	0	4.7	0	6.5	0	1.8	3.7
Biochemical oxygen demand, 5-day, parts per million	51.2	6.9	35.6	7.2	31.8	10.4	16.3

[1] Miles from mouth of Ohio to mouth of tributary. [2] Less than one.

Hydrometric Data

Sixteen stream-gaging stations have been maintained at various times on minor tributaries of the Ohio. Five of these stations are currently in operation. Table M–6 shows data on low summer flows at a few of the stations.

Table M–6.—*Minor tributary basins: Monthly mean summer flows for years in which low summer flows have occurred*

River	Chartiers Creek	Little Beaver	Middle Island Creek	Raccoon Creek
Location	Carnegie, Pa.	East Liverpool, Ohio	Little, W. Va.	Adamsville, Ohio
River miles above—				
Confluence with Ohio	8	4	25	25
Mouth of Ohio [1]	978	942	827	705
Drainage area, square miles	264	505	458	587
Period of record	1919–33	1915–40	1915–20, 1925–40	1915–35, 1938–40
Year	1927	1932	1930	1930
June, cubic feet per second	325	76	11	29
July, do	135	131	2	11
August, do	62	26	0	14
September, do	24	17	0	3
Year	1929	1930	1932	1922
June, cubic feet per second	155	102	51	548
July, do	96	30	255	72
August, do	44	22	166	7
September, do	26	28	2	152
Year	1932	1939	1936	1932
June, cubic feet per second	60	359	5	57
July, do	67	226	108	255
August, do	30	103	34	25
September, do	26	29	6	11

[1] Miles above mouth of Ohio at mouth of tributary stream.

A large part of the flow of Chartiers Creek is mine drainage. Other minor tributaries are subject to extremely low flows.

Proposed flow regulation.—One of the reservoir sites studied by the United States Engineer Department for Ohio River flood control is located on Twelvepole Creek, a minor tributary which enters the Ohio River near Huntington, W. Va. This is a relatively clean stream receiving a small amount of sewage from one rural community. Low-flow regulation by the proposed reservoir would have no appreciable tangible value for pollution abatement.

Discussion

Pollution problems on the minor tributaries of the Ohio are predominantly local in nature and are concerned primarily with prevention or correction of offensive conditions in small streams subject to extremely low flows. An exception to this is the acid problem which must be attacked on a more or less basin-wide scale, at least in the upper third of the Ohio Basin. None of the nine surface water supplies shown in table M–2 is subject to heavy sewage pollution and although adequate bacteriological data are not available, it is probable that the water-treatment plants are not overloaded. Several of the

water supplies are affected by acid mine drainage, notably the Harrisburg, Ill., supply.

Recreational use of these minor tributaries is extensive, particularly in the neighborhood of the large Ohio River cities. The small tributaries are usually the cleanest streams for water sports and the rugged terrain through which most of them run is attractive for summer cottages. Even in the upper part of the basin, where mine acid has damaged many of the streams, there are some which are notable for their recreational value.

The low flows to which most of the streams are subject make rather complete treatment of wastes necessary for the prevention of local nuisance conditions. Each stream, however, presents more of an individual problem than is the case in the larger tributary basins where the effects of pollution may be felt more generally.

Most of the sewage is already being treated. Some of the existing plants appear to be inadequate. Estimated costs of a suggested program for abatement of sewage and industrial waste pollution are summarized in table M–1. Reduction in the mine acid load is badly needed. The cost of work to accomplish this is shown in the section on acid mine drainage.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Chartiers Creek above city limits, Washington, Pa.	OCh 37	Oct. 7, 1940		18.0	8.2	85.4	1.3	46	6.8	5	108	
Do	do	Oct. 15, 1940		14.0	6.2	59.3	1.5	9	6.5	12	152	
Do	do	Oct. 23, 1940		7.0	9.5	77.7	.6	2	6.6	12	161	
Do	do	Nov. 12, 1940	15	8.5	9.3	79.1	1.2	46	6.9	21	127	
Do	do	Nov. 25, 1940	16	4.5	10.4	79.8	.9	21	6.7	8	149	
Do	do	Dec. 5, 1940	12	4.0	12.9	98.1	1.3	43	6.7	10	124	
Do	do	Dec. 17, 1940	12	3.5	11.5	86.2	.5	23	6.9	20	98	
Do	do	Dec. 27, 1940		8.5	10.3	87.9	.8	46	6.7	7	129	
Chartiers Creek, 2 miles below sewage treatment plant, Washington, Pa.	OCh 34	Oct. 7, 1940		20.0	0	0	34.5	1,100	6.7	71	146	
Do	do	Oct. 15, 1940		15.0	1.5	14.8	6.2 [1] 42.2	11,000	5.8	115	15	
Do	do	Oct. 23, 1940		9.0	0	0	6.9 [1] 24.6	2,300	5.9	145	19	
Do	do	Nov. 12, 1940	19	8.5	5.5	47.2	13.5	24,000	7.1	40	132	
Do	do	Nov. 25, 1940	24	4.5	6.7	51.6	9.1	9,300	6.8	26	135	
Do	do	Dec. 5, 1940	22	3.0	9.9	73.4	7.6	2,300	6.7	90	92	
Do	do	Dec. 17, 1940	18	4.0	10.0	76.3	4.7	2,300	7.0	30	107	
Do	do	Dec. 27, 1940		10.0	6.7	59.1	10.6	11,000	6.9	28	135	
Chartiers Creek, 0.1 mile below Meadowlands, Pa.	OCh 29	Oct. 7, 1940		18.5	0	0	23.5	1,100	6.7	98	135	
Do	do	Oct. 15, 1940		14.0	0	0	40.6	110,000	6.6	90	138	
Do	do	Oct. 23, 1940		8.5	0	0	44.0	0	6.3	140	65	
Do	do	Nov. 12, 1940	24	8.5	1.0	8.5	12.0	4,600	6.8	46	110	
Do	do	Nov. 25, 1940	41	5.5	1.9	15.4	21.7	2,300	6.8	38	138	
Do	do	Dec. 5, 1940	27	3.0	8.6	63.8	16.3	2,300	6.5	100	16	
Do	do	Dec. 17, 1940	31	3.5	8.0	60.4	6.2	2,300	7.1	40	110	
Do	do	Dec. 27, 1940		10.0	2.4	21.3	12.9	4,600	6.7	35	110	
Chartiers Creek, below Houston, Pa.	OCh 26	Oct. 7, 1940		18.0	2.5	25.9	3.5 [1] 4.4	39	5.6	88	7	
Do	do	Oct. 15, 1940		13.5	0	0	11.0	93	6.0	93	7	
Do	do	Oct. 23, 1940		8.0	5.1	43.1	6.6	240	6.5	22	71	
Do	do	Nov. 12, 1940	36	7.5	3.6	29.9	5.0	93	6.6	68	49	
Do	do	Nov. 25, 1940	58	5.0	6.9	53.8	3.1	1,100	6.8	33	91	
Do	do	Dec. 5, 1940	38	1.0	10.9	76.6	5.4	430	6.7	45	92	
Do	do	Dec. 17, 1940	40	4.0	8.8	67.0	5.8	2,400	7.1	30	99	
Do	do	Dec. 27, 1940		9.0	7.0	60.4	5.7	2,400	6.9	18	118	

Chartiers Creek, ½ mile below Canonsburg, Pa.	OCh 23	Oct. 7, 1940		19.0	2.4	25.6	5.0 [1] 17.8	1,100	4.0	23		
Do	do	Oct. 15, 1940		15.0	2.0	19.8	7.0 [1] 20.5	230	3.3	28		
Do	do	Oct. 23, 1940		9.0	.3	2.4	12.9	430	6.0	32	11	
Do	do	Nov. 12, 1940	42	9.5	2.8	24.1	5.6	230	6.4	34	6	
Do	do	Nov. 25, 1940	73	6.0	7.5	59.9	11.4	23	6.2	22	8	
Do	do	Dec. 5, 1940	44	1.0	12.3	86.5	5.8	460	6.8	70	80	
Do	do	Dec. 17, 1940	51	4.0	10.5	79.8	5.6	4,600	7.2	30	98	
Do	do	Dec. 27, 1940		9.0	9.3	80.4	5.9	11,000	7.0	23	122	
Chartiers Creek, 1 mile below Morganza, Pa.	OCh 21	Oct. 7, 1940		18.0	.9	9.4	4.1	460	6.6	90	36	
Do	do	Oct. 15, 1940		13.0	2.4	23.1	7.1 [1] 15.2	4,600	5.5	108	5	
Do	do	Oct. 23, 1940		8.5	1.6	13.6	15.6	910	6.1	115	13	
Do	do	Nov. 12, 1940	42	7.0	5.0	40.7	3.0	91	6.4	68	23	
Do	do	Nov. 25, 1940	75	4.5	7.2	55.6	7.1	93	6.2	35	8	
Do	do	Dec. 5, 1940	45	1.0	12.1	84.9	7.3	93	6.7	70	56	
Do	do	Dec. 17, 1940	52	4.5	9.8	75.7	3.4	240	7.0	40	63	
Do	do	Dec. 27, 1940		9.0	9.1	78.2	5.5	240	7.1	23	136	
Miller Run, ½ mile above Cecil, Pa.	OChM 16.5	Oct. 1, 1940		13.0	10.9	103.0	6.4	(2)	3.1	13		
Do	do	Oct. 8, 1940		12.0	8.7	80.0	7.1	0	3.0	16		
Do	do	Oct. 17, 1940		4.0	12.4	94.2	6.4 [1] .0	0	2.8	38		
Do	do	Oct. 24, 1940		10.0	9.4	83.4	6.5 [1] 2.8	0	3.0	49		
Do	do	Nov. 5, 1940		9.5	10.1	88.3	7.2 [1] 2.0	0	4.5	79	15	
Do	do	Nov. 18, 1940	2	1.0	12.5	87.7	6.3 [1] 2.8	0	4.5	120	8	
Do	do	Nov. 29, 1940	9	2.0	12.4	89.7	.8	11	6.4	60	84	
Do	do	Dec. 11, 1940	4	3.0	12.6	93.3	.9	110	6.3	55	100	
Do	do	Dec. 23, 1940	2	4.5	10.6	81.5	1.7 [1] 1.2	9	5.6	150	12	
Miller Run, ¾ mile below Cecil, Pa.	OChM 15.5	Oct. 1, 1940		13.0	9.4	88.7	7.3 [1] 1.7	0	3.0	6		
Do	do	Oct. 8, 1940		12.5	9.1	84.8	7.0 [1] .9	0	3.0	18		
Do	do	Oct. 17, 1940		3.5	11.7	88.2	7.4 [1] 1.9	0	2.8	12		
Do	do	Oct. 24, 1940		10.0	9.2	80.9	6.5 [1] 2.6	0	3.1	15		
Do	do	Nov. 5, 1940		9.0	9.8	84.6	.9 [1] 2.0	11	5.3	94	8	
Do	do	Nov. 18, 1940	3	0.0	12.2	83.5	6.3 [1] 2.4	0	5.0	110	11	
Do	do	Nov. 29, 1940	13	2.0	12.8	92.3	.8	11	6.6	55	99	
Do	do	Dec. 11, 1940	8	3.0	12.4	92.4	.8	110	6.8	80	99	
Do	do	Dec. 23, 1940	2	4.0	10.0	76.2	1.4 [1] .8	23	5.4	220	24	

[1] Seeded and neutralized.

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Robinson Run, above Midway, Pa	OChR 22.5	Oct. 2, 1940		12.0	8.1	74.4	1.6	110	7.4	45	237	
Do	do	Oct. 10, 1940		6.0	7.1	57.2	1.2	93	7.0	8	259	
Do	do	Oct. 21, 1940		5.0	8.0	62.1	.1	150	6.6	6	244	
Do	do	Oct. 28, 1940		8.0	9.2	77.9	7.6	1,100	6.8	12	236	
Do	do	Nov. 7, 1940	(2)	5.0	10.6	82.8	1.0	43	6.8	18	220	
Do	do	Nov. 20, 1940	(2)	4.5	10.3	79.1	.5	460	6.5	10	231	
Do	do	Dec. 3, 1940	(2)	0.0	12.6	85.9	.6	15	6.8	15	203	
Do	do	Dec. 13, 1940	(2)	6.0	10.9	87.2	.9	23	6.8	35	169	
Robinson Run, below Midway, Pa	OChR 21.5	Oct. 2, 1940		11.0	9.8	88.2	0.9 [1] 1.2	(2)	3.2	28		
Do	do	Oct. 10, 1940		6.5	10.5	84.9	.7 [1] 1.7	(2)	3.1	31		
Do	do	Oct. 21, 1940		5.5	11.1	87.9	1.5 [1] 2.2	1	2.9	42		
Do	do	Oct. 28, 1940		8.0	10.6	89.0	1.7 [1] .9	1	3.2	36		
Do	do	Nov. 7, 1940	1	5.0	11.5	89.7	1.0 [1] 1.0	(2)	4.5	39	5	
Do	do	Nov. 20, 1940	1	4.5	12.2	94.2	1.0 [1] 1.8	(2)	4.4	40	8	
Do	do	Dec. 3, 1940	2	1.5	13.0	92.4	.8 [1] 1.4	(2)	4.6	85	5	
Do	do	Dec. 13, 1940	1	5.5	11.1	88.1	.6	24	6.1	50	23	
Robinson Run, ¼ mile above McDonald, Pa.	OChR 19	Oct. 2, 1940		12.0	10.4	96.4	7.5 [1] 1.1	0	2.9	37		
Do	do	Oct. 10, 1940		6.5	8.4	76.3	7.5 [1] 1.2	0	2.8	32		
Do	do	Oct. 21, 1940		5.0	9.5	74.3	7.4 [1] .4	0	2.4	28		
Do	do	Oct. 28, 1940		7.5	10.4	86.6	7.5 [1] 2.3	0	2.8	17		
Do	do	Nov. 7, 1940	2	4.5	11.5	88.5	6.8 [1] 1.4	(2)	3.5	87		
Do	do	Nov. 20, 1940	2	5.0	11.8	91.9	8.1 [1] 1.9	(2)	3.3	90		
Do	do	Dec. 3, 1940	4	1.0	14.6	102.4	6.9 [1] 1.8	(2)	4.0	170		
Do	do	Dec. 13, 1940	2	6.5	11.3	91.5	3.0 [1] 1.2	(2)	4.5	100	6	

Robinson Run, ¼ mile below McDonald, Pa.	OChR 17.5	Oct. 2, 1940		14.0	8.2	78.9	7.1 / [1]7.3	(2)	3.1	152		
Do	do	Oct. 10, 1940		6.5	10.0	81.2	7.8 / [1]2.7	(2)	2.9	138		
Do	do	Oct. 21, 1940		5.5	10.3	81.2	7.0 / [1]6.1	1	2.4	225		
Do	do	Oct. 28, 1940		9.0	11.0	94.9	5.7 / [1]7.3	(2)	3.1	195		
Do	do	Nov. 7, 1940	2	4.0	11.0	84.0	6.4 / [1]3.0	4	4.2	70		
Do	do	Nov. 20, 1940	2	5.0	12.0	93.7	9.0 / [1]4.4	110	3.7	75		
Do	do	Dec. 3, 1940	5	0	14.1	96.3	7.4 / [1]4.1	4	4.3	150	5	
Do	do	Dec. 13, 1940	3	7.0	10.8	88.7	4.8 / [1]2.5	9	4.5	110	8	
North Fork Robinson Run, ½ mile above Oakdale, Pa.	OChRNf 15.5	Oct. 1, 1940		11.5	10.7	97.8	1.0 / [1]1.4	0	2.8	4		
Do	do	Oct. 8, 1940		12.5	7.2	66.8	1.8 / [1]1.4	0	2.9	4		
Do	do	Oct. 17, 1940		4.0	12.0	91.6	1.3 / [1]1.3	0	2.6	4		
Do	do	Oct. 24, 1940		10.0	10.2	89.8	.9 / [1]1.7	0	2.9	4		
Do	do	Nov. 5, 1940		9.5	10.8	93.9	1.5 / [1]1.2	0	3.3	11		
Do	do	Nov. 18, 1940	3	.5	11.9	82.5	1.9 / [1].6	(2)	3.3	95		
Do	do	Nov. 29, 1940	17	4.0	12.9	98.5	1.7 / [1].8	11	3.2	85		
Do	do	Dec. 11, 1940	6	3.0	12.8	95.1	1.0 / [1]1.1	0	2.8	85		
Do	do	Dec. 23, 1940	3	4.5	12.2	94.0	.9 / [1]1.2	0	2.9	60		
Robinson Run, upper limits, Oakdale, Pa.	OChR 15.5	Oct. 1, 1940		12.0	10.3	95.3	7.9 / [1]2.4	0	2.9	19		
Do	do	Oct. 8, 1940		11.0	9.0	81.3	6.9	0	3.0	17		
Do	do	Oct. 17, 1940		4.0	9.0	68.5	7.8 / [1]6.0	0	2.8	21		
Do	do	Oct. 24, 1940		10.0	7.6	66.8	6.3 / [1]3.7	0	3.1	52		
Do	do	Nov. 5, 1940		10.5	10.1	90.0	8.3 / [1]5.4	2	3.8	48		
Do	do	Nov. 18, 1940	4	.5	12.3	85.0	7.9 / [1]5.0	24	3.7	110		
Do	do	Nov. 29, 1940	24	3.5	12.9	97.3	4.9 / [1]2.0	0	4.4	85	9	
Do	do	Dec. 11, 1940	8	3.0	12.4	92.0	6.6 / [1]2.0	(2)	3.8	130		
Do	do	Dec. 23, 1940	4	3.5	12.2	91.9	6.2 / [1]2.3	5	3.8	120		

[1] Seeded and neutralized. [2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Robinson Run, ¾ mile below Oakdale, Pa.	OChR 14.5	Oct. 1, 1940		12.0	9.5	87.3	5.7 [1] 2.2	0	2.8	17		
Do	do	Oct. 8, 1940		11.5	6.9	62.7	[1] 3.3	0	3.0	8		
Do	do	Oct. 17, 1940		3.5	10.2	76.8	4.3 [1] 3.0	0	2.7	11		
Do	do	Oct. 24, 1940		10.0	7.7	68.2	4.8 [1] 3.0	0	3.1	14		
Do	do	Nov. 5, 1940		10.5	10.1	89.9	6.2 [1] 4.6	2	3.5	32		
Do	do	Nov. 18, 1940	8	.0	13.3	91.0	5.3 [1] 2.7	4	3.5	75		
Do	do	Nov. 29, 1940	42	1.5	14.0	99.9	3.3 [1] 1.4	1	3.9	85		
Do	do	Dec. 11, 1940	14	2.5	12.9	94.6	4.3 [1] 2.3	1,100	3.1	90		
Do	do	Dec. 23, 1940	7	4.0	12.5	95.3	3.4 [1] 2.1	0	3.0	110		
Chartiers Creek, above Carnegie, Pa	OCh 8.5	Oct. 1, 1940		14.0	7.0	67.3	8.8 [1] 8.0	14	3.9	25		
Do	do	Oct. 8, 1940		13.5	4.2	40.2	8.4 [1] 3.7	9	3.4	17		
Do	do	Oct. 17, 1940		5.5	6.0	47.6	7.2 [1] 13.1	2	3.4	14		
Do	do	Oct. 24, 1940		11.0	4.1	36.9	7.5 [1] 28.4	0	3.4	11		
Do	do	Nov. 5, 1940		11.0	8.1	73.3	7.3 [1] 18.5	11	5.3	90	11	
Do	do	Nov. 18, 1940	78	2.0	10.7	77.1	5.3 [1] 7.0	2	5.1	95	8	
Do	do	Nov. 29, 1940	134	1.5	11.7	83.5	2.9	110	6.3	125	12	
Do	do	Dec. 11, 1940	93	3.5	11.0	83.0	2.6	23	6.0	95	30	
Do	do	Dec. 23, 1940	81	4.5	10.3	79.4	3.5	93	6.1	120	52	
Chartiers Creek, below Carnegie, Pa	OCh 6.5	Oct. 1, 1940		14.5	6.2	60.5	7.8 [1] 7.9	6	3.2	35		
Do	do	Oct. 8, 1940		15.0	6.2	60.9	.5 [1] 3.8	46	4.0	34		
Do	do	Oct. 17, 1940		7.5	6.9	57.2	7.0 [1] 21.9	14	3.3	28		
Do	do	Oct. 24, 1940		12.0	5.6	51.7	7.3 [1] 17.8	4	3.5	64		

Do	do	Nov. 5, 1940	----------	11.0	8.2	74.5	8.3 [1] 18.9	9	5.0	71	7	----------
Do	do	Nov. 18, 1940	86	2.0	9.3	67.5	8.0 [1] 20.2	110	5.2	130	12	----------
Do	do	Nov. 29, 1940	178	2.0	11.6	83.6	3.8	23	6.1	90	8	----------
Do	do	Dec. 11, 1940	112	4.0	11.3	86.0	5.4	240	6.0	90	24	----------
Do	do	Dec. 23, 1940	90	5.0	10.8	84.1	6.3 [1] 8.6	4	5.4	110	11	----------
Raccoon Creek, ¼ mile above Burgettstown, Pa.	ORa 32.5	Oct. 2, 1940	----------	13.0	9.1	85.7	6.4 [1] 2.1	0	2.9	88	----------	----------
Do	do	Oct. 10, 1940	----------	10.0	9.0	79.4	6.8 [1] 4.8	0	2.8	63	----------	----------
Do	do	Oct. 21, 1940	----------	9.5	9.2	80.3	7.0 [1] 2.8	0	2.5	162	----------	----------
Do	do	Oct. 28, 1940	----------	12.0	11.5	106.3	6.4 [1] 3.5	0	2.9	112	----------	----------
Do	do	Nov. 7, 1940	5	7.0	10.9	89.2	4.2 [1] 2.6	2	3.9	108	----------	----------
Do	do	Nov. 20, 1940	4	7.5	10.5	87.2	7.5 [1] 1.8	1	3.4	170	----------	----------
Do	do	Dec. 3, 1940	13	1.0	12.4	87.4	7.2 [1] 2.8	0	4.5	230	8	----------
Do	do	Dec. 13, 1940	5	6.0	10.4	83.6	3.0 [1] 1.5	2	5.6	130	32	----------
Raccoon Creek, ½ mile below Burgettstown, Pa.	ORa 31.5	Oct. 2, 1940	----------	11.5	10.2	92.7	6.5 [1] 2.8	[2]	2.9	33	----------	----------
Do	do	Oct. 10, 1940	----------	8.0	7.7	64.9	7.5 [1] 4.0	0	2.5	4	----------	----------
Do	do	Oct. 21, 1940	----------	6.5	9.7	78.4	8.0 [1] 2.0	0	2.5	45	----------	----------
Do	do	Oct. 28, 1940	----------	9.0	9.6	82.7	7.4 [1] 3.7	0	2.9	30	----------	----------
Do	do	Nov. 7, 1940	7	5.5	11.1	87.6	7.5 [1] 3.5	8	3.4	148	----------	----------
Do	do	Nov. 20, 1940	6	5.5	11.1	88.1	7.9 [1] 3.0	1	3.3	120	----------	----------
Do	do	Dec. 3, 1940	17	.0	13.3	90.8	7.7 [1] 4.0	2	4.3	200	6	----------
Do	do	Dec. 13, 1940	10	6.5	11.7	94.7	7.7 [1] 1.6	0	4.2	180	----------	----------
Raccoon Creek, at mouth	ORa 0.5	Nov. 7, 1940	----------	7.0	11.2	91.6	1.7 [1] 2.0	[2]	4.9	3	5	----------
Do	do	Nov. 15, 1940	57	4.0	12.0	91.2	.6	[2]	6.1	6	5	----------
Do	do	Nov. 25, 1940	59	5.5	11.1	88.0	2.8 [1] 3.2	[2]	4.9	6	1	----------
Do	do	Dec. 11, 1940	----------	3.0	12.6	93.6	.8 [1] 1.3	2	5.9	23	11	----------
Do	do	Dec. 17, 1940	71	5.0	12.0	93.9	.7	[2]	6.7	22	8	----------
Do	do	Dec. 23, 1940	65	3.5	12.0	90.3	.7 [1] 2.2	[2]	5.8	22	7	----------

[1] Seeded and neutralized.

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Middle Fork Little Beaver River, 1 mile above Salem, Ohio.	OLbMf 37	June 28, 1940	(2)	18.5	9.5	100.5	1.9	43	8.0	13	135	----------
Do	do	July 10, 1940	(2)	22.0	5.4	61.7	2.9	23	7.5	----------	----------	----------
Do	do	July 29, 1940	2	24.0	2.6	30.2	3.1	240	6.8	----------	----------	----------
Middle Fork Little Beaver River, 4 miles below Salem, Ohio.	OLbMf 32	June 28, 1940	5	19.0	5.6	60.3	4.7	91	7.4	----------	132	140
Do	do	July 10, 1940	3	21.5	5.9	66.2	2.0	23	7.6	7	----------	202
Do	do	July 29, 1940	32	25.0	4.1	49.0	12.7	240	7.6	15	----------	172
Middle Fork, Little Beaver, 1 mile above Leetonia, Ohio.	OLbMf 35.5	June 26, 1940	1	13.5	8.9	85.2	6.4	460	7.1	----------	64	----------
Do	do	June 28, 1940	1	18.5	8.8	92.8	.6	23	7.4	----------	----------	----------
Do	do	July 10, 1940	1	20.5	6.0	66.2	.9	2	7.2	----------	----------	----------
Middle Fork, Little Beaver, 1 mile below Leetonia, Ohio.	OLbMf 33.5	June 26, 1940	3	17.0	6.3	64.4	2.2	73	7.6	----------	107	----------
Do	do	June 28, 1940	4	19.5	6.4	68.8	2.6	91	7.4	20	----------	194
Do	do	July 10, 1940	2	21.0	5.3	59.3	.8	91	7.4	18	----------	214
Middle Fork, Little Beaver, ¾ mile above Lisbon, Ohio.	OLbMf 25	June 26, 1940	38	16.5	8.7	88.6	1.2	9	7.3	----------	109	----------
Do	do	Sept. 26, 1940	----------	11.5	9.5	86.5	1.5	43	7.0	8	120	----------
Do	do	Oct. 3, 1940	----------	12.0	9.2	84.9	1.0	4	7.0	8	128	----------
Do	do	Oct. 22, 1940	----------	3.0	11.0	81.4	.6	2	6.3	9	131	----------
Do	do	Oct. 31, 1940	----------	6.0	9.6	77.1	1.7	11	7.3	9	147	----------
Do	do	Nov. 8, 1940	22	4.5	11.3	87.3	1.1	46	6.8	6	107	----------
Do	do	Nov. 22, 1940	20	10.0	11.1	97.7	.8	93	6.6	5	115	----------
Do	do	Dec. 4, 1940	37	0	13.5	92.1	1.5	430	6.6	5	80	----------
Do	do	Dec. 16, 1940	25	5.0	12.6	98.6	1.2	430	6.6	30	64	----------
Do	do	Dec. 26, 1940	----------	4.5	12.7	97.6	1.3	230	6.7	5	84	----------
Middle Fork, Little Beaver, 2 miles below Lisbon, Ohio.	OLbMf 22	June 26, 1940	60	19.0	8.1	86.4	1.8	2,400	7.9	10	103	188
Do	do	Sept. 26, 1940	----------	11.0	8.8	79.1	2.1	460	7.2	11	121	----------
Do	do	Oct. 3, 1940	----------	12.5	6.9	64.7	2.9	91	7.1	12	131	----------
Do	do	Oct. 22, 1940	----------	3.0	9.1	67.4	4.6	930	6.3	18	136	----------
Do	do	Oct. 31, 1940	----------	7.5	9.2	76.9	2.1	430	7.1	8	137	----------
Do	do	Nov. 8, 1940	23	4.0	10.8	82.5	2.2	240	7.0	9	113	----------
Do	do	Nov. 22, 1940	21	9.0	10.7	92.6	1.3	460	6.8	8	116	----------
Do	do	Dec. 4, 1940	38	1.5	13.6	97.1	1.8	230	6.6	5	77	----------
Do	do	Dec. 16, 1940	26	5.0	12.0	93.8	3.5	930	6.7	45	54	----------
Do	do	Dec. 26, 1940	----------	3.5	12.4	93.2	2.4	430	6.8	11	83	----------
Leslie Run, 1 mile above East Palestine, Ohio.	OLbL 17.5	June 26, 1940	1	19.0	8.8	93.6	2.8	4	8.3	----------	90	----------

Leslie Run, 2 miles below East Palestine, Ohio.	OLbL 14.5	do	7	16.5	9.4	95.9	2.8	430	7.9	5	127	180
Little Beaver River, at mouth	OLb 0.2	Sept. 26, 1940		13.5	10.3	98.0	1.3	43	7.0	16	96	
Do	do	Sept. 30, 1940		14.5	9.5	92.7	1.0	4	6.7	15	50	
Do	do	Oct. 2, 1940		15.0	9.7	95.6	.6	(2)	6.5	5	46	
Do	do	Oct. 4, 1940		15.5	9.6	95.7	.6	(2)	6.4	8	58	
Do	do	Oct. 8, 1940		16.0	9.2	92.4	1.1	5	6.6	9	50	
Do	do	Oct. 10, 1940		13.5	10.0	95.2	1.0	2	6.4	10	58	
Do	do	Oct. 14, 1940		13.5	9.6	91.3	.9	46	6.4	9	54	
Do	do	Oct. 16, 1940		13.0	9.8	92.1	1.2	46	6.4	8	45	
Do	do	Oct. 18, 1940		12.5	10.2	95.2	1.1	9	6.2	7	45	
Do	do	Oct. 22, 1940		9.0	11.1	95.9	1.1	9	6.0	8	67	
Do	do	Oct. 24, 1940		12.0	10.4	96.2	1.1	9	6.4	7	52	
Do	do	Oct. 28, 1940		11.5	10.4	94.9	1.0	9	6.3	8	44	
Do	do	Oct. 30, 1940		11.5	10.3	94.1	.7	4	7.1	6	58	
Do	do	Nov. 1, 1940		10.5	10.8	95.9	1.2	9	7.1	6	79	
Do	do	Nov. 5, 1940		9.5	10.9	95.4	2.0	9	6.4	8	107	
Do	do	Nov. 7, 1940		6.0	11.7	93.8	.8	2	6.9	5	94	
Do	do	Nov. 13, 1940		5.0	12.3	96.2	1.1	24	7.0	15	85	
Do	do	Nov. 15, 1940		3.5	12.7	95.3	.8	2	6.9	7	84	
Do	do	Nov. 19, 1940		1.0	14.1	99.3	1.0	(2)	6.5	10	84	
Do	do	Nov. 25, 1940		5.0	12.6	98.2	.9	1	6.8	6	93	
Do	do	Nov. 27, 1940		2.0	13.0	94.1	2.5	110	6.8	85	67	
Do	do	Nov. 29, 1940		.5	14.0	96.9	1.5	36	6.5	18	54	
Do	do	Dec. 5, 1940		.5	14.1	97.7	1.1	9	6.8	22	61	
Do	do	Dec. 9, 1940		.5	14.3	99.0	1.0	110	6.4	5	69	
Do	do	Dec. 11, 1940		2.0	13.6	98.3	1.0	9	6.5	7	63	
Do	do	Dec. 13, 1940		4.5	12.4	95.6	1.2	2	6.6	23	61	
Do	do	Dec. 17, 1940		4.0	12.5	95.0	2.6	11	7.0	130	41	
Do	do	Dec. 19, 1940		1.0	13.8	97.0	.8	3	6.6	17	39	
Do	do	Dec. 23, 1940		3.0	13.2	97.5	.9	43	6.5	12	60	
Do	do	Dec. 31, 1940		3.5	12.8	96.0	1.1	46	6.9	60	24	
Do	do	Jan. 2, 1941		4.5	12.5	96.5	.7	9	6.8	18	33	
Yellow Creek, ¼ mile above Amsterdam, Ohio.	OY 25	Oct. 22, 1940		2.5	12.1	88.8	.9	9	6.4	7	97	
Do	do	Oct. 31, 1940		6.5	10.6	86.2	2.0	11	7.2	8	69	
Do	do	Nov. 8, 1940	2	2.5	13.0	95.4	1.0	460	7.1	8	73	
Do	do	Nov. 22, 1940	2	11.0	11.4	103.1	.8	39	7.1	10	69	
Do	do	Dec. 4, 1940	6	2.0	14.0	101.5	.7	46	6.8	5	54	
Do	do	Dec. 16, 1940	3	8.0	11.6	97.6	1.4	43	6.8	130	35	
Do	do	Dec. 26, 1940		5.5	12.3	97.1	.8	23	6.8	15	45	
Yellow Creek, 1 mile below Amsterdam, Ohio.	OY 23.5	Oct. 22, 1940		4.0	12.4	94.2	1.2	93	6.3	6	60	
Do	do	Oct. 31, 1940		6.5	10.7	87.1	1.1	240	7.3	8	59	
Do	do	Nov. 8, 1940	3	3.0	12.6	93.3	.9	4	6.8	10	48	
Do	do	Nov. 22, 1940	3	11.5	11.1	101.5	.8	24	7.0	5	59	
Do	do	Dec. 4, 1940	7	2.0	13.6	98.1	1.0	23	6.7	6	45	
Do	do	Dec. 16, 1940	4	8.0	11.8	99.2	1.7	75	6.8	130	36	
Do	do	Dec. 26, 1940		5.0	11.9	93.1	.7	240	6.9	28	38	

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Riley Run, ¾ mile above Salineville, Ohio.	OYR 13	Sept. 26, 1940		10.0	11.2	98.4	.8	93	7.3	8	30	
Do	do	Oct. 3, 1940		12.0	9.8	90.3	.7	9	7.0	7	14	
Do	do	Oct. 22, 1940		1.5	12.0	85.4	1.2	15	6.3	22	10	
Do	do	Oct. 31, 1940		5.0	11.1	87.0	1.5	4	7.3	6	39	
Do	do	Nov. 8, 1940	1	2.5	12.8	93.7	.7	24	7.1	7	36	
Do	do	Nov. 22, 1940	1	10.5	11.2	99.6	.5	24	6.9	6	38	
Do	do	Dec. 4, 1940	2	2.0	13.7	99.2	.8	4	6.8	6	30	
Do	do	Dec. 16, 1940	2	7.0	11.7	96.3	2.0	24	6.8	210	18	
Do	do	Dec. 26, 1940		5.0	12.4	96.9	.8	93	6.9	6	20	
Riley Run, ½ mile below Salineville, Ohio.	OYR 11.5	Sept. 26, 1940		10.5	11.4	101.7	1.1	240	7.2	3	41	
Do	do	Oct. 3, 1940		12.5	9.6	89.8	1.3	28	7.0	Trace	47	
Do	do	Oct. 22, 1940		2.0	11.8	84.9	1.5	93	6.2	4	43	
Do	do	Oct. 31, 1940		6.0	11.0	87.8	.8	460	7.2	3	46	
Do	do	Nov. 8, 1940	3	3.0	12.4	91.8	.5	23.	6.9	3	45	
Do	do	Nov. 22, 1940	3	11.5	11.0	100.5	.7	43	6.9	3	23	
Do	do	Dec. 4, 1940	5	3.0	13.7	101.7	.8	23	6.8	6	36	
Do	do	Dec. 16, 1940	5	7.0	11.7	96.4	2.5	460	6.7	110	20	
Do	do	Dec. 26, 1940		5.0	12.2	95.4	1.1	230	6.8	12	29	
North Fork Yellow Creek, above Irondale, Ohio.	OYNf 5	Sept. 26, 1940		12.0	11.0	101.4	1.2	24	7.2	3	67	
Do	do	Oct. 3, 1940		13.5	9.3	89.0	.9	2	7.0	2	55	
Do	do	Oct. 22, 1940		7.0	11.8	96.6	.7	1	6.4	4	57	
Do	do	Oct. 31, 1940		8.5	10.9	92.6	1.1	2	7.3	4	69	
Do	do	Nov. 8, 1940	5	3.0	12.4	92.1	.7	(³)	6.9	4	51	
Do	do	Nov. 22, 1940	5	12.0	11.6	107.5	.5	2	6.9	4	35	
Do	do	Dec. 4, 1940	8	3.0	14.0	104.0	.8	11	6.8	7	38	
Do	do	Dec. 16, 1940	7	9.0	11.9	103.0	1.6	24	6.9	85	26	
Do	do	Dec. 26, 1940		6.0	12.4	99.4	.6	15	6.9	6	34	
North Fork Yellow Creek, ¾ mile below Irondale, Ohio.	OYNf 3.5	Sept. 26, 1940		12.5	11.4	106.7	1.1	46	7.2	3	61	
Do	do	Oct. 3, 1940		13.5	10.3	98.6	.8	24	7.0	Trace	60	
Do	do	Oct. 22, 1940		7.5	12.4	103.1	.7	36	6.4	3	60	
Do	do	Oct. 31, 1940		9.0	11.5	99.3	.7	93	7.1	3	68	
Do	do	Nov. 8, 1940	5	3.5	12.7	95.7	.8	46	6.8	118	51	
Do	do	Nov. 22, 1940	5	12.0	11.4	105.6	.9	9	6.9	5	51	
Do	do	Dec. 4, 1940	8	2.5	13.9	101.5	.8	9	6.8	7	33	
Do	do	Dec. 16, 1940	8	8.0	11.9	100.2	1.5	150	6.9	90	25	
Do	do	Dec. 26, 1940		6.0	12.3	98.8	.7	9	6.9	5	30	

Yellow Creek at mouth	*OY 0.2*	*Nov. 14, 1940*	30	4.0	12.7	96.8	.5	24	6.6	9	59	
Do	do	Nov. 27, 1940	153	3.0	12.6	93.3	2.9	150	7.1	210	46	
Do	do	Dec. 9, 1940	72	1.5	13.8	98.5	.6	4	7.0	7	46	
Do	do	Dec. 19, 1940	36	1.0	13.5	95.0	.4	9	7.1	12	36	
Do	do	Jan. 2, 1941	359	6.0	12.2	97.9	.6	9	6.9	23	25	
Harmon Creek, mouth, West Virginia Route No. 2.	OH 0.2	Nov. 12, 1940	56	19.0	7.6	80.8	6.7 [1] 22.1	0	2.7	19		
Do	do	Nov. 18, 1940	50	18.5	9.2	97.4	10.4 [1] 19.6	(2)	2.7	15		
Do	do	Nov. 26, 1940	61	15.0	7.7	76.0	7.7 [1] 6.4	43	2.9	12		
Do	do	Dec. 2, 1940	55	12.0	9.4	86.4	8.2 [1] 32.4	24	2.8	55		
Do	do	Dec. 10, 1940	65	15.0	8.9	87.7	7.2 [1] 16.7	15	2.8	40		
Do	do	Dec. 18, 1940	48	12.0	9.9	91.1	6.1 [1] 12.0	9	2.8	60		
Do	do	Dec. 26, 1940	70	15.0	8.7	85.4	4.0 [1] 19.1	(2)	2.1	13		
Cross Creek, mouth, Ohio Route No. 7.	OCr 0.2	Nov. 14, 1940	38	4.0	13.0	99.2	.7	9	6.7	9	95	
Do	do	Nov. 27, 1940	134	3.0	12.4	92.4	2.6	240	7.0	170	54	
Do	do	Dec. 9, 1940	50	1.0	13.9	97.9	.5	9	6.8	23	79	
Do	do	Dec. 19, 1940	37	1.0	13.9	97.4	.4	4	7.1	22	69	
Do	do	Jan. 2, 1941	205	6.0	12.2	98.0	.5	2	6.8	60	43	
Cross Creek, mouth, West Virginia Route No. 2.	OCr 0.2	Nov. 12, 1940	18	9.0	11.6	100.1	1.6	110	7.0	53	113	
Do	do	Nov. 18, 1940	17	2.0	12.4	89.7	1.0	240	6.7	35	88	
Do	do	Nov. 26, 1940	16	2.0	13.4	96.6	1.7	0	7.0	30	101	
Do	do	Dec. 2, 1940	20	2.5	13.5	98.9	2.0	43	6.8	60	97	
Do	do	Dec. 10, 1940	24	4.0	12.8	97.6	1.7	1,100	6.6	45	99	
Do	do	Dec. 18, 1940	17	4.0	13.0	98.7	.9	23	6.8	40	98	
Do	do	Dec. 26, 1940	26	6.0	12.4	99.5	.8	93	6.8	35	105	
Buffalo Creek, mouth 0.8, West Virginia Route No. 67.	OBu 0.8	Nov. 14, 1940	37	6.0	12.5	100.1	.6	4	7.0	9	141	
Do	do	Nov. 22, 1940	36	10.0	11.4	100.9	.7	9	6.9	10	135	
Do	do	Nov. 28, 1940	160	2.0	13.2	95.2	1.3	5	6.9	55	88	
Do	do	Dec. 6, 1940	45	0	14.2	96.9	.7	4	6.9	22	40	
Do	do	Dec. 12, 1940	70	5.0	12.8	99.6	.7	15	6.8	12	124	
Do	do	Dec. 20, 1940		4.5	13.0	100.3	.6	7	7.1	7	126	
Do	do	Dec. 24, 1940		2.0	13.7	99.2	.8	8	7.1	5	131	
Middle Fork Short Creek below Cadiz, Ohio.	OShMf 25.3	Sept. 27, 1940		10.0	10.4	91.9	1.8	1,100	7.1	5	157	
Do	do	Oct. 9, 1940		10.0	3.3	28.9	15.4	11,000	6.9	20	198	
Do	do	Oct. 25, 1940		10.0	7.6	66.7	3.2	910	7.3	5	193	
Do	do	Nov. 1, 1940		9.5	7.8	68.0	4.4	4,600	6.9	8	183	
Do	do	Nov. 6, 1940	2	7.0	10.3	84.5	2.7	2,300	6.8	13	168	
Do	do	Nov. 19, 1940	2	0	11.3	77.3	1.5	930	6.7	10	160	
Do	do	Dec. 2, 1940	6	0	13.3	90.8	1.2	150	6.8	6	140	
Do	do	Dec. 12, 1940	4	4.5	12.0	92.6	1.0	43	6.8	7	136	
Do	do	Dec. 24, 1940	2	0	13.9	95.1	1.5	240	6.9	7	148	

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Short Creek, upper limits, Adena, Ohio.	OSh 17.3	Sept. 27, 1940		10.0	12.6	111.0	.8	240	7.2	5	116	
Do	do	Oct. 9, 1940		9.5	11.6	101.0	.9	23	7.0	3	129	
Do	do	Oct. 25, 1940		9.0	9.7	84.0	1.0	93	6.7	2	126	
Do	do	Nov. 1, 1940		9.0	10.1	87.2	.8	15	6.9	4	128	
Do	do	Nov. 6, 1940	40	7.5	11.2	93.3	1.0	150	6.9	21	119	
Do	do	Nov. 19, 1940	35	0	14.4	98.5	.6	46	6.9	15	153	
Do	do	Dec. 2, 1940	86	0	14.0	95.4	.9	43	7.1	6	135	
Do	do	Dec. 12, 1940	90	4.5	12.4	96.0	.8	43	6.9	30	126	
Do	do	Dec. 24, 1940	85	0	14.6	99.9	.6	23	7.0	5	143	
Short Creek, ¾ mile below Adena, Ohio.	OSh 16.3	Sept. 27, 1940		10.0	10.5	92.5	1.4	240	7.0	25	69	
Do	do	Oct. 9, 1940		9.5	11.4	99.4	.7	460	6.8	10	60	
Do	do	Oct. 25, 1940		10.0	9.7	85.5	1.3	430	6.7	10	66	
Do	do	Nov. 1, 1940		9.0	10.5	90.4	1.1	36	6.8	8	85	
Do	do	Nov. 6, 1940	40	7.5	11.1	92.6	1.0	460	6.8	50	75	
Do	do	Nov. 19, 1940	36	0	13.9	95.2	.9	460	6.8	35	112	
Do	do	Dec. 2, 1940	88	0	13.6	92.7	.9	460	7.1	50	97	
Do	do	Dec. 12, 1940	93	4.5	12.2	93.7	.6	23	6.8	50	93	
Do	do	Dec. 24, 1940	88	0	13.4	91.8	.8	460	6.9	40	102	
Short Creek, ½ mile above Dillonvale, Ohio.	OSh 10	Nov. 13, 1940	40	4.0	6.8	51.8	.2	9	6.3	125	22	
Do	do	Nov. 26, 1940	50	2.0	9.0	65.3	.7	150	6.7	120	13	
Do	do	Dec. 6, 1940	38	2.0	11.0	79.2	1.1	21	6.6	110	53	
Do	do	Dec. 18, 1940	82	4.0	11.7	88.9	.6	23	6.9	80	73	
Do	do	Dec. 30, 1940		4.5	11.8	91.2	.8	23	6.7	130	47	
Do	do	Dec. 31, 1940	290	4.5	11.9	91.7	.6	43	6.8	95	59	
Short Creek, 1¼ miles below Dillonvale, Ohio.	OSh 8.3	Nov. 13, 1940	41	4.0	9.2	69.9	1.0	46	6.5	131	31	
Do	do	Nov. 26, 1940	52	2.0	9.6	69.5	.9	240	6.6	125	13	
Do	do	Dec. 6, 1940	39	2.0	11.7	84.4	.7	23	6.6	110	66	
Do	do	Dec. 18, 1940	83	4.0	12.1	92.4	.8	150	6.9	75	71	
Do	do	Dec. 30, 1940		3.5	12.0	90.1	3.4	93	6.7	2,600	63	
Do	do	Dec. 31, 1940	300	3.5	12.2	91.6	.7	39	6.8	100	52	
Piney Fork Creek, above Piney Fork, Ohio.	OShPi 12.3	Sept. 27, 1940		13.0	11.3	106.8	.7	9	7.0	8	47	
Do	do	Oct. 9, 1940		10.5	10.8	96.2	1.0	46	6.9	5	68	
Do	do	Oct. 25, 1940		9.0	10.1	87.2	.9	43	6.6	6	93	
Do	do	Nov. 1, 1940		9.0	10.5	90.9	.8	23	6.9	7	87	

Do	do	Nov. 6, 1940	6	6.5	11.1	89.9	.7	9	7.0	22	65	----------
Do	do	Nov. 19, 1940	5	0	13.9	95.0	.5	4	6.9	25	84	----------
Do	do	Dec. 2, 1940	14	2.0	13.3	96.0	.8	9	7.0	30	67	----------
Do	do	Dec. 12, 1940	9	5.0	12.4	97.0	.6	(2)	6.8	23	69	----------
Do	do	Dec. 24, 1940	4	0	14.0	95.7	.6	11	7.0	45	80	----------
Piney Fork Creek, below Piney Fork, Ohio.	OShPi 11.3	Sept. 27, 1940	----------	13.5	10.4	99.1	1.3	1,100	7.0	24	37	----------
Do	do	Oct. 9, 1940	----------	11.0	11.0	99.1	1.9	0	6.8	25	57	----------
Do	do	Oct. 25, 1940	----------	10.0	6.5	57.2	6.3	460	6.1	86	11	----------
Do	do	Nov. 1, 1940	----------	9.5	8.3	72.3	{6.7 / [1] 15.1}	0	4.9	58	12	----------
Do	do	Nov. 6, 1940	6	7.0	8.6	70.7	2.5	93	6.7	61	25	----------
Do	do	Nov. 19, 1940	5	1.0	9.5	66.5	2.2	93	6.6	55	39	----------
Do	do	Dec. 2, 1940	14	1.0	12.9	90.7	1.1	43	6.9	100	54	----------
Do	do	Dec. 12, 1940	9	5.0	11.1	86.9	.8	93	6.6	40	53	----------
Do	do	Dec. 24, 1940	5	1.0	13.3	93.3	.8	43	6.9	40	67	----------
Short Creek, mouth, Ohio, route, No. 7	OSh 0.2	Nov. 14, 1940	43	4.0	6.2	47.2	1.6	46	6.0	138	9	----------
Do	do	Nov. 27, 1940	155	3.5	11.8	88.9	2.0	93	6.9	250	36	----------
Do	do	Dec. 9, 1940	75	1.5	11.4	81.2	1.0	93	6.7	130	50	----------
Do	do	Dec. 19, 1940	55	1.0	12.0	84.3	.5	93	6.8	130	60	----------
Do	do	Jan. 2, 1941	330	6.5	11.1	89.8	.6	240	6.8	120	70	----------
Wheeling Creek, mouth, West Virginia, route No. 2.	OWh 0.1	Nov. 4, 1940	----------	9.0	10.3	88.6	2.0	110	6.5	24	83	----------
Do	do	Nov. 6, 1940	----------	10.0	9.6	84.8	1.9	1,100	6.7	23	95	----------
Do	do	Nov. 14, 1940	203	6.0	10.9	87.3	1.4	1,100	6.9	28	92	----------
Do	do	Nov. 22, 1940	184	10.5	9.3	82.6	2.7	430	6.5	30	90	----------
Do	do	Nov. 28, 1940	450	3.0	12.1	89.9	1.6	430	6.8	45	63	----------
Wheeling Creek, mouth, West Virginia, route No. 2.	OWh 0.1	Dec. 6, 1940	175	.5	13.0	90.0	3.1	2,400	6.8	30	101	----------
Do	do	Dec. 12, 1940	281	5.0	12.0	93.5	2.8	930	6.7	25	89	----------
Do	do	Dec. 20, 1940	181	4.5	12.0	92.6	2.1	4,600	6.9	21	82	----------
Do	do	Dec. 24, 1940	----------	2.0	12.2	88.2	2.0	430	6.9	23	84	----------
Wheeling Creek, 2¼ miles below Flushing, Ohio.	OWh 24.7	May 10, 1940	3	13.0	9.9	93.6	.9	4	7.0	----------	86	----------
Do	do	May 13, 1940	2	20.0	8.8	96.4	.9	9	7.2	----------	----------	----------
Do	do	May 15, 1940	1	17.0	9.0	92.6	.8	4	7.2	----------	----------	----------
Wheeling Creek, 1¼ miles below Laferty, Ohio.	OWh 23.7	May 10, 1940	8	11.5	9.1	82.7	.5	4	6.6	55	35	380
Do	do	May 13, 1940	6	18.0	7.6	79.6	.3	1	6.5	38	----------	404
Do	do	May 15, 1940	4	17.0	4.3	43.9	.1	(2)	6.0	63	----------	244
Wheeling Creek, 1½ miles above Fairpoint, Ohio.	OWh 20.2	Sept. 30, 1940	----------	13.5	7.9	75.6	.6	0	6.8	60	36	----------
Do	do	Oct. 18, 1940	----------	7.0	8.3	67.9	1.2	1	6.2	19	11	----------
Do	do	Oct. 29, 1940	----------	9.5	10.0	87.3	1.2	(2)	6.3	24	15	----------
Do	do	Nov. 4, 1940	----------	7.0	10.9	89.3	.8	24	6.4	45	92	----------
Do	do	Nov. 13, 1940	17	3.0	11.9	88.1	.9	8	6.8	49	98	----------
Do	do	Nov. 26, 1940	18	1.0	12.6	88.5	.8	2	6.9	45	119	----------
Do	do	Dec. 6, 1940	15	0	11.9	81.4	.7	(2)	6.3	70	90	----------
Do	do	Dec. 18, 1940	17	3.5	12.4	93.3	.9	11	6.7	45	113	----------
Do	do	Dec. 30, 1940	----------	4.0	12.3	93.7	.9	9	6.4	60	59	----------
Do	do	Dec. 31, 1940	56	4.0	12.3	93.9	.6	24	6.6	55	77	----------

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Wheeling Creek, ½ mile below Fairpoint, Ohio.	OWh 18.2	Sept. 30, 1940		13.5	5.6	53.4	2.0	0	6.5	50	21	
Do	do	Oct. 18, 1940		7.0	4.6	38.1	2.9	5	6.0	12	158	
Do	do	Oct. 29, 1940		9.5	10.2	89.3	4.9	9	6.2	23	8	
Do	do	Nov. 4, 1940		7.0	10.8	88.3	.6	24	6.4	93	72	
Do	do	Nov. 13, 1940	18	3.0	11.5	85.2	.6	4	6.8	72	98	
Do	do	Nov. 26, 1940	19	1.0	11.8	83.1	Broke	1	6.6	55	105	
Do	do	Dec. 6, 1940	16	0	12.0	82.0	.6	(2)	6.5	50	92	
Do	do	Dec. 18, 1940	18	3.5	12.3	92.7	.4	2	6.8	40	113	
Do	do	Dec. 30, 1940		4.0	12.1	92.0	1.2	2	6.5	130	57	
Do	do	Dec. 31, 1940	60	4.5	12.1	93.6	.3	24	6.7	65	79	
Town Run, below south sewage plant, St. Clairsville, Ohio.	OWhT 13.2	Sept. 30, 1940		14.5	3.1	30.2	14.2	43	7.3	13	230	
Do	do	Oct. 18, 1940		9.5	4.5	39.6	5.9	1,100	6.6	14	209	
Do	do	Oct. 29, 1940		11.5	2.1	18.8	30.9	2,400	6.8	32	225	
Do	do	Nov. 4, 1940		10.0	8.4	73.8	7.9	4,600	6.8	10	182	
Do	do	Nov. 13, 1940	(2)	6.0	8.9	71.6	9.5	4,600	7.1	10	180	
Do	do	Nov. 26, 1940	(2)	6.0	7.6	60.7	19.6	24,000	7.3	130	197	
Do	do	Dec. 6, 1940		3.5	9.2	69.1	19.9	7,500	6.9	30	165	
Do	do	Dec. 18, 1940	(2)	6.0	10.1	80.8	12.9	1,500	7.0	20	144	
Do	do	Dec. 30, 1940		5.5	10.9	86.5	12.4	4,300	6.8	40	71	
Do	do	Dec. 31, 1940	(2)	6.5	10.9	88.3	17.0	360	6.8	70	89	
Wheeling Creek, ½ mile above Barton, Ohio.	OWh 10.7	Sept. 30, 1940		15.5	5.0	49.8	2.5	4	6.7	31	19	
Do	do	Oct. 18, 1940		9.0	11.0	94.8	3.6 [1]1.5	(2)	3.3	21		
Do	do	Oct. 29, 1940		10.5	10.0	89.4	3.3 [1]1.0	(2)	3.4	33		
Do	do	Nov. 4, 1940		8.0	11.0	92.8	.8	2	6.8	66	51	
Do	do	Nov. 13, 1940	32	3.5	12.2	92.1	.9	5	7.2	85	76	
Do	do	Nov. 26, 1940	38	1.0	12.3	86.5	.4	4	7.2	80	68	
Do	do	Dec. 6, 1940	38	1.0	13.3	93.6	.6	9	6.9	100	98	
Do	do	Dec. 18, 1940	26	3.5	12.6	95.0	.6	4	7.2	80	111	
Do	do	Dec. 30, 1940		4.0	12.0	91.6	1.2	15	7.0	150	68	
Do	do	Dec. 31, 1940	84	4.5	12.3	94.5	.4	24	7.0	90	88	
Wheeling Creek, ¾ mile below Barton, Ohio.	OWh 9.2	Sept. 30, 1940		15.5	9.7	96.5	8.3 [1]1.2	0	4.7	33	6	
Do	do	Oct. 18, 1940		8.5	11.4	97.2	7.4 [1]2.1	0	3.4	14		
Do	do	Oct. 29, 1940		10.5	10.4	92.7	5.5 [1]1.0	1	3.3	31		

Do	do	Nov. 4, 1940		7.5	11.5	95.6	1.6	24	6.6	99	32	
Do	do	Nov. 13, 1940	32	3.5	13.1	98.5	.5	8	6.7	106	45	
Do	do	Nov. 26, 1940	39	1.0	10.6	74.2	1.7	4	6.7	95	25	
Do	do	Dec. 6, 1940	39	1.0	13.4	94.1	.6	4	6.8	95	93	
Do	do	Dec. 18, 1940	27	3.5	12.1	90.8	.6	9	7.1	90	99	
Do	do	Dec. 30, 1940		4.5	11.9	91.5	.7	8	6.0	150	66	
Do	do	Dec. 31, 1940	88	4.5	12.0	92.9	.3	4	7.0	95	84	
Wheeling Creek, mouth, Ohio Route No. 7.	OWh 0.2	Nov. 14, 1940	35	4.0	12.3	93.9	2.6	1,100	6.7	94	59	
Do	do	Nov. 27, 1940	145	4.0	12.8	97.7	2.7	910	7.0	250	70	
Do	do	Dec. 9, 1940	68	2.0	13.3	96.0	1.1	230	6.9	95	100	
Do	do	Dec. 19, 1940	40	1.0	13.4	94.3	.5	43	7.1	45	109	
Do	do	Jan. 2, 1941	267	6.5	11.9	96.7	.8	93	6.9	70	110	
Aults Run-Little McMahon below north sewage, St. Clairsville, Ohio.	OMcLmA 10.7	Sept. 30, 1940		14.5	10.2	99.2	1.9	110,000	7.4	6	210	
Do	do	Oct. 18, 1940		10.5	6.4	57.3	11.2	9,300	6.3	13	200	
Do	do	Oct. 29, 1940		11.0	5.1	45.9	20.0	4,300	6.6	22	190	
Do	do	Nov. 4, 1940		11.0	6.7	60.1	11.2	11,000	7.0	9	186	
Do	do	Nov. 13, 1940	(2)	7.0	7.8	64.1	16.7	24,000	7.3	21	195	
Do	do	Nov. 26, 1940	(2)	3.0	8.1	59.9	11.5	23,000	7.1	8	193	
Do	do	Dec. 6, 1940		4.0	10.3	78.6	7.3	9,300	7.1	11	181	
Do	do	Dec. 18, 1940	(2)	7.0	9.9	81.2	13.2	24,000	7.1	20	161	
Do	do	Dec. 30, 1940		5.0	10.3	80.1	17.5	4,300	6.9	30	91	
Do	do	Dec. 31, 1940	(2)	7.0	10.0	82.3	8.6	24,000	7.0	21	124	
McMahon Creek, mouth, Ohio Route No. 7.	OMc 0.2	Nov. 14, 1940	54	4.5	11.6	89.3	.6	2	6.8	32	74	
Do	do	Nov. 27, 1940	167	5.0	12.0	93.6	2.1	240	7.0	140	79	
Do	do	Dec. 9, 1940	83	4.5	12.7	98.2	.8	9	6.9	25	105	
Do	do	Dec. 19, 1940	55	1.0	13.1	92.2	.5	4	7.0	23	106	
Do	do	Jan. 2, 1941	224	6.0	11.5	92.3	.7	460	6.8	22	106	
North Fork, Captina Creek, 2½ miles below Barnesville, Ohio.	OCpNf 31.0	May 10, 1940	3	10.5	10.8	96.3	2.8	240	7.9		139	
Do	do	May 13, 1940	2	16.5	13.0	131.9	1.8	460	8.4	4		180
Do	do	May 15, 1940	2	19.5	11.3	122.2	1.9	23	8.4	8		196
Bend Fork, Captina Creek, 3 miles below Bethesda, Ohio.	OCpB 27.0	May 10, 1940	1	11.5	12.2	111.0	2.2	23	7.8	7	101	148
Do	do	May 13, 1940	1	17.0	14.4	148.2	1.6	9	8.6			
Do	do	May 15, 1940	1	18.0	12.3	128.6	1.9	9	7.8			
Sunfish Creek, 1.1 miles above Woodsfield, Ohio.	OSf 22.9	May 24, 1940		17.5	8.9	92.6	4.4	1,100	7.4	420	61	
Do	do	June 4, 1940		17.5	10.6	109.7	.8	15	7.2	2	55	
Do	do	June 13, 1940		23.0	9.0	103.9	1.2	150	7.8	54	68	
Do	do	June 21, 1940		14.0	10.7	103.3	.8	23	6.9	12	65	
Do	do	July 1, 1940		17.0	9.2	94.6	1.7	110	6.8	90	36	
Do	do	July 18, 1940		20.5	9.7	106.7	.9	91	8.0	12	75	
Do	do	July 26, 1940		24.5	8.4	99.5	.8	91	7.5	8	72	
Do	do	Aug. 5, 1940		23.0	7.6	87.1	.9	23	7.8	4	87	
Do	do	Aug. 13, 1940		23.5	8.1	94.5	1.1	24	7.9	4	94	
Do	do	Aug. 21, 1940		16.0	9.7	97.9	1.2	150	7.4	13	84	
Do	do	Aug. 29, 1940		20.0	8.8	95.5	1.0	430	7.3	13	52	

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Sunfish Creek, 1.1 miles above Woodsfield, Ohio.	OSf 22.9	Sept. 6, 1940		18.0	9.7	101.6	.4	9	6.9	4	78	
Do	do	Sept. 16, 1940		14.0	9.9	95.7	.7	4	7.1	Trace	90	
Do	do	Jan. 20, 1941		1.5	14.7	104.6	1.3	2	7.5	6	42	
Sunfish Creek, 1.5 miles below Woodsfield, Ohio.	OSf 21.4	May 24, 1940		18.5	9.0	95.1	1.4	150	7.8	30	79	
Do	do	June 4, 1940		19.5	10.6	114.7	.7	21	7.6	2	68	
Do	do	June 13, 1940		23.5	8.4	97.7	1.6	93	7.8	160	66	
Do	do	June 21, 1940		15.0	10.6	104.1	.4	15	7.4	9	74	
Do	do	July 1, 1940		17.0	9.3	95.8	1.6	1,100	6.9	180	39	
Do	do	July 18, 1940		21.5	9.4	105.6	.9	0	8.1	58	81	
Do	do	July 26, 1940		26.0	7.7	93.4	1.1	43	7.7	38	79	
Do	do	Aug. 5, 1940		23.0	4.2	48.4	1.5	23	7.9	12	97	
Do	do	Aug. 13, 1940		24.0	6.4	74.4	.9	9	7.8	14	109	
Do	do	Aug. 21, 1940		16.5	9.6	98.0	1.1	110	7.6	69	95	
Do	do	Aug. 29, 1940		21.5	8.7	97.5	1.2	930	7.3	54	61	
Do	do	Sept. 6, 1940		19.0	10.4	111.5	.5	0	7.4	5	97	
Do	do	Sept. 16, 1940		14.0	9.9	95.4	.6	9	7.0	1	102	
Do	do	Jan. 20, 1941		2.5	14.8	108.5	.7	24	7.6	5	50	
Middle Island Creek, St. Marys, W. Va.	OMi 0.1	July 24, 1940		27.0	6.5	80.4	1.4	23	6.8	18	32	
Do	do	Aug. 9, 1940		25.0	5.9	70.4	1.1	46	7.4	150	39	
Do	do	Aug. 19, 1940		25.0	4.4	52.8	.9	46	7.1	135	31	
Do	do	Aug. 27, 1940		22.5	4.3	49.6	.4	0	6.9	67	42	
Do	do	Sept. 4, 1940		24.5	7.2	85.5	.7	24	7.1	62	39	
Do	do	Sept. 12, 1940		17.5	7.2	74.2	.8	24	6.8	52	39	
Little Muskingum River, at mouth	OLmu 0.1	May 1, 1940		16.5	9.0	91.1	.8	2	6.8	17	90	
Do	do	May 7, 1940		15.0	9.9	97.9	.9	2	7.5	12	99	
Do	do	May 9, 1940		18.0	8.9	93.4	.9	1	7.2	18	94	
Do	do	May 13, 1940		15.0	8.8	86.3	1.0	2	7.1	11	102	
Do	do	May 15, 1940		15.0	8.0	78.4	3.8	11	6.9	2,100	59	
Do	do	May 17, 1940		14.5	9.6	93.4	.9	2	6.4	56	24	
Do	do	May 21, 1940		18.0	8.7	91.6	.9	2	7.3	25	87	
Do	do	May 23, 1940		20.0	9.0	97.7	.9	5	7.4	22	92	
Do	do	May 27, 1940		15.5	9.0	89.9	.9	11	6.7	110	58	
Do	do	May 29, 1940		17.0	8.8	90.2	.6	110	6.9	36	71	
Do	do	May 31, 1940		16.5	9.2	93.1	1.8	460	6.5	230	54	
Do	do	June 4, 1940		18.0	8.7	91.4	.6	240	6.8	48	68	
Do	do	June 6, 1940		21.0	7.8	87.0	.7	23	7.4	20	80	
Do	do	June 10, 1940		24.0	6.8	79.2	1.9	290	7.4	450	89	

Do	do	June 12, 1940		20.5	7.3	80.4	3.5	460	7.3	1,800	73	
Do	do	June 14, 1940		22.5	7.2	82.3	1.4	0	7.2	385	59	
Do	do	June 18, 1940		22.0	7.0	79.8	2.9	1,100	7.0	1,600	63	
Do	do	June 20, 1940		20.0	7.5	81.8	1.2	430	7.1	270	62	
Do	do	June 24, 1940		23.0	8.1	93.1	1.0	91	7.0	58	39	
Do	do	June 26, 1940		22.0	7.5	85.2	.9	0	7.3	48	95	
Do	do	June 28, 1940		23.0	8.6	98.6	.9	23	7.3	34	105	
Do	do	July 2, 1940		17.0	7.8	79.6	2.3	460	7.3	550	59	
Do	do	July 10, 1940		23.5	9.2	107.4	1.0	0	7.2	17	94	
Do	do	July 12, 1940		24.0	8.4	97.9	1.5	15	7.0	20	87	
Do	do	July 16, 1940		24.0	8.2	96.5	1.6	9	7.4	20	85	
Do	do	July 18, 1940		24.5	7.6	89.8	1.0	2	7.6	15	116	
Do	do	July 22, 1940		27.5	6.7	83.5	1.4	9	7.8	13	123	
Do	do	July 24, 1940		26.5	5.9	72.0	2.5	460	7.4	370	110	
Do	do	July 26, 1940		28.0	7.2	91.3	1.5	9	7.0	235	28	
Do	do	July 30, 1940		29.0	7.7	99.0	1.0	4	6.9	22	15	
Do	do	Aug. 1, 1940		27.0	6.9	85.4	1.8	46	7.2	200	40	
Do	do	Aug. 5, 1940		27.5	8.0	100.3	1.2	2	6.8	9	15	
Do	do	Aug. 7, 1940		26.5	7.4	90.8	1.4	24	7.4	15	20	
Do	do	Aug. 9, 1940		25.5	6.1	73.1	1.6	110	7.0	355	66	
Do	do	Aug. 13, 1940		27.5	7.2	90.0	1.3	0	7.1	12	12	
Do	do	Aug. 15, 1940		27.0	7.1	87.8	1.0	2	6.5	14	11	
Do	do	Aug. 19, 1940		26.5	7.1	87.2	1.0	11	6.1	32	17	
Do	do	Aug. 21, 1940		25.0	8.1	97.1	.7 [1] .3	0	5.8	7		
Do	do	Aug. 23, 1940		24.5	8.6	102.2	.3 [1] 1.0	(2)	5.4	4		
Do	do	Aug. 27, 1940		24.0	8.2	95.6	.5	2	6.3	11	8	
Do	do	Aug. 29, 1940		21.5	6.2	69.7	3.0	460	6.8	1,650	76	
Do	do	Sept. 4, 1940		23.0	8.4	96.9	1.2	0	6.5	52	39	
Do	do	Sept. 6, 1940		23.5	8.2	95.6	.3	9	6.0	12	10	
Do	do	Sept. 10, 1940		22.5	8.5	97.5	.6 [1] 1.1	15	5.3	10	6	
Do	do	Sept. 12, 1940		20.5	8.9	97.7	.2 [1] .9	2	5.6	12	11	
Do	do	Sept. 16, 1940		20.0	9.3	101.0	1.0 [1] 1.0	1	4.5	3	5	
Do	do	Jan. 15, 1941		1.0	13.5	94.6	.6	1	6.7	5	93	
Do	do	Jan. 17, 1941		4.0	12.4	94.3	1.0	11	6.8	60	69	
Do	do	Jan. 21, 1941		.5	13.7	94.7	1.1	2	7.7	21	36	
Do	do	Jan. 23, 1941		2.0	13.5	97.7	1.0	46	7.3	45	66	
Do	do	Jan. 27, 1941		2.5	13.0	95.2	1.3	7	7.1	120	42	
Do	do	Jan. 29, 1941		1.5	13.0	92.5	1.3	4	7.2	60	46	
Do	do	Jan. 31, 1941		1.5	13.4	95.5	.6	93	7.3	25	65	
Do	do	Feb. 4, 1941		.5	13.4	92.8	1.6	4	7.5	12	80	
Do	do	Feb. 6, 1941		1.5	13.4	95.5	.4	(2)	7.4	7	82	
Do	do	Mar. 6, 1941		.5	13.4	93.1	2.0	9	7.5	140	55	
Do	do	Mar. 10, 1941		1.0	13.7	96.5	.9	9	7.6	25	64	
Do	do	Mar. 12, 1941		2.0	12.8	92.6	1.2	4	7.5	130	45	
Do	do	Mar. 14, 1941		1.5	13.2	94.2	.6	9	7.4	35	48	

[1] Seeded and neutralized.

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Little Muskingum River at mouth	do	Mar. 18, 1941		.0	13.6	93.2	.9	4	7.6	15	67	
Do	do	Mar. 20, 1941		1.0	14.0	98.4	.6	(2)	7.7	7	73	
Do	do	Mar. 24, 1941		5.0	12.9	100.9	.9	0	7.8	18	117	
Do	do	Mar. 26, 1941		5.0	12.2	95.5	.7	1	7.4	8	82	
Do	do	Mar. 28, 1941		5.5	12.5	99.1	.7	0	7.6	12	86	
Duck Creek, city limits, above Caldwell, Ohio.	OD 37.1	May 24, 1940		18.5	7.6	80.3	4.9	1,100	7.7	550	91	
Do	do	June 4, 1940		22.0	8.2	93.1	1.1	7	7.5	36	117	
Do	do	June 13, 1940		25.0	7.5	89.5	1.0	43	7.8	120	92	
Do	do	June 21, 1940		17.0	8.5	87.3	.6	23	7.2	48	119	
Do	do	July 1, 1940		19.0	8.2	88.1	2.8	460	7.1	430	64	
Do	do	July 18, 1940		24.0	8.5	99.8	1.2	36	8.0	38	137	
Do	do	July 26, 1940		28.5	7.3	93.2	2.0	9	7.7	41	153	
Do	do	Aug. 5, 1940		26.0	6.4	77.3	1.6	0	8.0	52	142	
Do	do	Aug. 13, 1940		26.5	6.1	75.1	1.6	2	7.8	18	136	
Do	do	Aug. 21, 1940		20.0	5.6	61.0	1.8	24	7.5	112	127	
Do	do	Aug. 29, 1940		24.0	6.1	71.8	2.1	430	7.1	490	89	
Duck Creek, 1.8 miles below Caldwell, Ohio.	OD 34.6	May 24, 1940		18.5	6.6	70.4	6.4	1,100	None	400	117	
Do	do	June 4, 1940		22.5	7.8	89.7	1.0	43	7.5	36	119	
Do	do	June 13, 1940		26.0	6.8	82.1	2.1	150	7.8	440	84	
Do	do	June 21, 1940		18.0	7.6	79.8	1.1	93	7.4	57	124	
Do	do	July 1, 1940		18.5	8.2	86.9	3.6	2,400	7.3	450	69	
Do	do	July 18, 1940		24.5	6.1	71.7	1.8	0	7.9	45	127	
Do	do	July 26, 1940		28.0	7.8	98.9	3.9	23	7.7	27	151	
Do	do	Aug. 5, 1940		25.0	6.2	73.6	3.0	24	8.0	63	160	
Do	do	Aug. 13, 1940		26.0	6.2	75.8	2.8	24	7.6	71	160	
Do	do	Aug. 21, 1940		20.0	5.8	63.2	3.1	110	7.3	138	138	
Do	do	Aug. 29, 1940		24.5	5.6	66.4	3.3	430	7.3	1,125	96	
Duck Creek, mouth	OD 0.2	May 7, 1940		15.5	9.9	98.9	1.1	4	7.7	8	120	
Do	do	May 9, 1940		17.5	8.9	92.3	1.3	46	7.4	24	121	
Do	do	May 13, 1940		15.0	8.6	84.2	3.4	9	7.3	9	125	
Do	do	May 15, 1940		17.0	8.3	84.8	1.0	24	7.3	22	127	
Do	do	May 17, 1940		14.5	9.5	92.5	.8	4	6.6	56	25	
Do	do	May 21, 1940		18.0	9.6	100.3	2.1	110	7.3	11	120	
Do	do	May 23, 1940		20.5	8.1	88.9	1.7	93	7.5	13	123	
Do	do	May 27, 1940		16.0	8.3	83.4	1.7	43	7.0	185	84	
Do	do	May 29, 1940		17.0	8.4	86.7	1.0	43	7.0	48	102	
Do	do	May 31, 1940		15.5	8.8	87.8	2.0	240	6.7	340	90	

Do	do	June 4, 1940		19.0	8.4	89.7	.9	460	7.0	55	104	
Do	do	June 6, 1940		22.0	7.8	87.9	.9	39	7.5	17	116	
Do	do	June 10, 1940		23.0	6.1	69.8	2.8	290	7.5	1,200	99	
Do	do	June 12, 1940		21.5	7.0	78.9	2.6	460	7.6	1,100	70	
Do	do	June 14, 1940		24.0	6.4	75.4	1.0	210	7.5	460	105	
Do	do	June 18, 1940		22.0	7.0	79.3	4.0	11,000	7.2	1,550	91	
Do	do	June 20, 1940		21.5	7.2	80.9	1.4		7.4	270	95	
Do	do	June 24, 1940		22.5	7.5	86.1	1.0		7.5	55	99	
Do	do	June 26, 1940		21.5	7.7	86.8	1.0	43	7.5	55	135	
Do	do	June 28, 1940		22.5	8.3	94.6	1.6	43	7.6	51	36	
Do	do	July 2, 1940		18.0	7.7	80.3	1.9	240	7.2	500	94	
Do	do	July 10, 1940		23.5	7.4	85.6	2.2	43	7.3	23	136	
Do	do	July 12, 1940		23.5	6.8	79.1	2.6	150	7.2	107	125	
Do	do	July 16, 1940		23.5	7.5	87.3	1.5	150	7.4	15	116	
Do	do	July 18, 1940		23.5	6.2	71.8	2.4	36	7.6	25	133	
Do	do	July 22, 1940		27.0	4.4	54.6	1.5	1,100	7.4	25	138	
Do	do	July 24, 1940		27.0	3.5	42.9	1.7	91	7.5	24	128	
Do	do	July 26, 1940		27.5	7.2	90.1	1.4	110	7.0	80	29	
Do	do	July 30, 1940		28.5	6.1	78.1	1.0	15	7.3	23	61	
Do	do	Aug. 1, 1940		26.5	4.0	49.1	2.3	110	7.0	151	40	
Do	do	Aug. 5, 1940		27.0	7.6	94.4	1.1	4	7.1	12	23	
Do	do	Aug. 7, 1940		26.0	5.2	62.8	1.8	110	7.6	78	46	
Do	do	Aug. 9, 1940		25.5	6.0	72.3	1.7	4	7.1	64	61	
Do	do	Aug. 13, 1940		27.5	6.8	85.5	1.3	9	7.2	14	21	
Do	do	Aug. 15, 1940		27.0	6.4	79.3	1.2	4	6.8	21	24	
Do	do	Aug. 19, 1940		26.5	5.8	71.1	1.5	15	6.5	68	30	
Do	do	Aug. 21, 1940		24.5	7.1	84.1	.8	2	6.5	17	17	
Do	do	Aug. 23, 1940		24.5	8.1	95.4	.8 [3]1.3	2	5.9	7		
Do	do	Aug. 27, 1940		24.0	8.0	94.1	.6	4	6.6	8	9	
Do	do	Aug. 29, 1940		21.5	6.3	71.0	3.5	2,400	7.1	1,300	100	
Do	do	Sept. 4, 1940		21.5	6.6	74.0	1.8	91	6.8	78	94	
Do	do	Sept. 6, 1940		23.0	7.7	88.5	1.1	46	6.4	21	25	
Do	do	Sept. 10, 1940		22.0	8.7	98.4	.9	9	6.1	15	13	
Do	do	Sept. 12, 1940		20.0	8.6	94.3	.7	110	6.0	16	19	
Do	do	Sept. 16, 1940		20.0	9.1	99.3	.7 [3]1.1	4	5.2	8	10	
Do	do	Jan. 15, 1941		1.0	13.6	95.9	.7	4	7.0	5	123	
Do	do	Jan. 17, 1941		3.5	12.5	94.1	1.3	2	6.9	85	31	
Do	do	Jan. 21, 1941		.5	13.5	93.5	1.9	15	7.1	15	103	
Do	do	Jan. 23, 1941		1.5	13.7	97.5	.9	15	7.5	50	106	
Do	do	Jan. 27, 1941		2.0	13.2	95.4	1.5	43	7.3	130	70	
Do	do	Jan. 29, 1941		1.0	13.2	92.8	1.2	93	7.5	65	74	
Do	do	Jan. 31, 1941		1.0	13.2	92.9	.8	23	7.5	23	93	
Do	do	Feb. 4, 1941		.5	13.1	90.8	.6	9	7.7	15	110	
Do	do	Feb. 6, 1941		1.5	13.5	96.1	.4	2	7.6	5	108	
Do	do	Mar. 6, 1941		.5	13.6	94.2	1.3	4	7.6	50	95	
Do	do	Mar. 10, 1941		.5	13.6	94.7	1.0	4	7.7	25	101	
Do	do	Mar. 12, 1941		2.5	12.9	94.2	2.8	12	7.4	160	82	
Do	do	Mar. 14, 1941		1.5	13.2	93.9	2.1	24	7.5	55	83	
Do	do	Mar. 18, 1941		.0	13.7	93.7	.4	2	7.8	15	101	

[3] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Duck Creek, mouth	do	Mar. 20, 1941		1.5	14.1	100.3	.6	2	7.8	7	114	
Do	do	Mar. 24, 1941		5.5	13.0	102.5	.8	4	7.7	22	82	
Do	do	Mar. 26, 1941		5.5	12.6	99.5	1.2	2	7.8	16	120	
Do	do	Mar. 28, 1941		5.0	12.2	95.7	1.6	2	7.8	12	120	
Shade River, mouth	OSh 0.1	May 24, 1941		20.0	7.7	84.1	1.3	9	7.3	50	102	
Do	do	June 3, 1941		18.0	8.0	84.1	1.1	23	6.9	80	64	
Do	do	June 11, 1941		24.0	6.6	77.8	1.5	43	7.6	335	83	
Do	do	June 17, 1941		23.5	6.9	80.2	1.8	240	7.4	700	92	
Do	do	June 25, 1941		22.0	7.4	83.5	2.0	460	7.2	650	77	
Do	do	July 1, 1941		22.0	7.6	85.9	.8	36	7.3	98	71	
Do	do	July 9, 1941		23.0	8.7	100.2	1.3	4	7.2	34	59	
Do	do	July 15, 1941		24.5	8.7	103.0	1.6	9	7.4	14	41	
Do	do	July 23, 1941		27.0	7.8	96.2	1.1	9	7.3	9	43	
Do	do	July 29, 1941		29.0	7.1	90.9	1.2	24	7.3	57	45	
Do	do	Aug. 6, 1941		28.0	7.9	99.4	1.8	9	7.6	11	32	
Do	do	Aug. 12, 1941		29.0	8.2	106.2	1.0	2	7.2	7	27	
Do	do	Aug. 20, 1941		25.0	5.8	69.4	1.1	4	7.2	48	53	
Do	do	Aug. 26, 1941		24.5	7.8	92.9	.8	24	7.2	11	33	
Do	do	Sept. 3, 1941		22.5	7.7	87.6	1.5	46	7.1	145	45	
Do	do	Sept. 9, 1941		23.5	8.5	98.7	1.0	4	6.8	14	30	
Pinchin Fork Bridge in McArthur, Ohio.	ORaElP 66.0	Apr. 17, 1940	142	11.5	10.6	97.1	.3	110	6.0			
Do	do	Apr. 19, 1940	399	8.5	10.9	93.2	1.8	150	6.1	310	12	
Do	do	Apr. 22, 1940	155	6.5	11.9	96.8	.8 1.7	3	4.8			
Pinchin Fork, ¼ mile below sewage plant, McArthur, Ohio.	ORaElP 64.0	Apr. 17, 1940	142	11.0	10.2	92.4	2.2	110	6.0	300		
Do	do	Apr. 19, 1940	399	7.5	10.7	89.1	2.9	23	5.7	425	4	50
Do	do	Apr. 22, 1940	155	7.0	11.4	94.0	1.8	36	4.8	59		
Raccoon Creek, 1 mile above Wellston, Ohio.	ORa 55.0	Apr. 17, 1940	64	12.5	9.8	91.5	4.4	240	6.1			
Do	do	Apr. 19, 1940	181	8.5	11.0	93.4	1.4	93	6.0			
Do	do	Apr. 22, 1940	70	8.5	10.6	96.7	1.2	7	6.1			
Raccoon Creek, 1 mile below Wellston, Ohio.	ORa 53.0	Apr. 17, 1940	64	12.0	8.7	80.0	2.8	1,100	6.1	260	23	
Do	do	Apr. 19, 1940	181	9.5	9.9	86.5	1.4	1,500	6.2	275	22	54
Do	do	Apr. 22, 1940	70	11.5	7.2	65.7	1.8	93	6.1	67	68	

Twelvepole Creek, 0.7 mile above Wayne, W. Va.	OTw 25.0	Dec. 15, 1939		0	12.3	83.9	.5	3				
Do	do	Jan. 19, 1940		0	12.5	85.1	1.2	(2)				
Do	do	Feb. 2, 1940		0	11.3	77.1	.6	(2)	6.6	5		
Do	do	Feb. 16, 1940		0	13.9	94.9	1.8	9				
Do	do	Feb. 23, 1940		2.5	12.8	93.7	.7	43				
Do	do	Mar. 15, 1940		4.0	12.5	95.3	.5	4				
Do	do	Mar. 29, 1940		11.0	10.4	93.6	.2	4				
Twelvepole Creek, corporate limit, below Wayne, W. Va.	OTw 24.0	Dec. 15, 1939		2.0	9.4	67.7	2.3	43	7.0	6	44	
Do	do	Jan. 19, 1940		0	13.1	89.7	1.0	110	6.6	6	20	
Do	do	Feb. 2, 1940		0	8.8	60.3	.7	75	6.7	5	23	
Do	do	Feb. 16, 1940		0	13.7	93.8	.6	9	6.5	37	13	
Do	do	Feb. 23, 1940		2.0	12.6	91.3	.6	15	6.8	18	12	
Do	do	Mar. 15, 1940		3.5	12.3	92.8	.7	43	6.6	16	19	
Do	do	Mar. 29, 1940		11.0	10.2	92.4	.4	43	6.9	5	22	
Little Sandy River, 4.1 miles above Grayson, Ky.	OLs 32.1	June 30, 1939		23.5	6.3	73.0	1.0	21	7.5	130	60	
Do	do	July 14, 1939		24.0	6.6	77.8	.6	9	7.5	20	56	
Do	do	July 28, 1939		24.0	6.7	78.7	1.9		7.2	1,400	45	
Do	do	Aug. 11, 1939		20.5	6.7	73.8	.9	9	7.5	38	76	
Do	do	Aug. 25, 1939		21.5	6.8	76.9	1.5	43	7.6	95	66	
Do	do	Sept. 8, 1939		22.0	6.5	73.5	.6	9	7.6	30	88	
Do	do	Sept. 22, 1939		16.5	6.3	63.9	1.0	24	7.5	22	90	
Do	do	Oct. 6, 1939		16.5	7.1	72.1	1.1	9	7.8	22	85	
Do	do	Oct. 20, 1939		11.0	7.8	70.3	1.1	43	7.6	10	92	
Do	do	Nov. 3, 1939		6.0	9.4	75.4	1.1	43	7.5	80	70	
Do	do	Nov. 17, 1939		5.5	10.4	82.0	1.0	0	7.2	18	81	
Do	do	Dec. 1, 1939		7.0	11.2	92.1	.6	4	7.5	12	85	
Do	do	Dec. 22, 1939		2.0	12.1	87.5	.5	9	7.5	17	83	
Do	do	Jan. 12, 1940		1.5	12.2	86.8	.5	(2)				
Do	do	Feb. 8, 1940		1.0	13.2	92.8	1.0		7.5	75	39	
Do	do	Mar. 1, 1940		4.0	12.4	94.1	.5	8	6.7	25	21	
Do	do	Mar. 22, 1940		7.5	11.3	93.9	.2	0				
Little Sandy River, 0.4 mile below Grayson, Ky.	OL's 27.6	June 30, 1939	52	23.5	5.5	63.7	.9	240	7.5	170	51	
Do	do	July 14, 1939	60	24.0	6.4	75.2	.4	23				
Do	do	July 28, 1939		24.0	7.1	83.6	.8	110	7.4	175	56	
Do	do	Aug. 11, 1939	38	21.0	6.2	68.4	.6	23				
Do	do	Aug. 25, 1939	44	22.0	6.4	72.5	1.2	43	7.7	120	58	
Do	do	Sept. 8, 1939	40	22.0	6.2	70.3	.7	75				
Do	do	Sept. 22, 1939	27	17.0	4.5	46.2	1.0	460				
Do	do	Oct. 6, 1939	45	16.5	7.0	71.4	.8	93				
Do	do	Oct. 20, 1939	34	10.5	6.1	54.6	1.3	43				
Do	do	Nov. 3, 1939	43	6.5	8.3	67.1	1.6	43			61	
Do	do	Nov. 17, 1939	35	5.5	9.0	70.9	1.2	93				
Do	do	Dec. 1, 1939	41	6.0	10.6	84.8	1.0	75				
Do	do	Dec. 22, 1939	47	2.5	11.0	80.5	.6	9				
Do	do	Jan. 12, 1940	48	2.0	11.1	80.1		93				
Do	do	Feb. 8, 1940	355	1.0	13.0	91.3	1.0	21	7.5			
Do	do	Mar. 1, 1940	758	4.5	12.4	95.8	.6	9				
		Mar. 22, 1940	250	7.5	11.1	92.4	.2	0				

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most popular number per milliliter	pH	Turbidity parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Little Sandy River, 1.8 mile below Grayson, Ky.	OLs 26.2	Aug. 11, 1939		22.0	5.6	63.6	1.0	460	7.4	42	64	
Do	do	Aug. 25, 1939		21.5	6.3	70.4	1.6	230	7.8	110	57	
Do	do	Sept. 8, 1939		22.0	5.9	66.8	1.3	460	7.6	35	83	
Do	do	Sept. 22, 1939		16.0	4.7	47.6	2.2	460	7.3	35	74	
Do	do	Oct. 6, 1939		16.5	6.5	66.0	.8	460	7.9	22	85	
Do	do	Oct. 20, 1939		10.5	5.6	50.0	1.4	460	7.6	10	80	
Do	do	Nov. 3, 1939		6.5	7.6	61.4	1.8	460	7.5	90	58	
Do	do	Nov. 17, 1939		5.0	8.0	62.5	1.7	240	7.0	22	69	
Do	do	Dec. 1, 1939		6.0	9.4	75.6	1.1	230	7.5	12	73	
Do	do	Dec. 22, 1939		2.5	10.1	74.2	1.0	150	7.5	17	72	
Do	do	Jan. 12, 1940		2.0	10.3	74.7	1.4	240	6.8	8	72	
Do	do	Feb. 8, 1940		1.0	13.0	91.1	1.1	15	7.5	75	42	
Do	do	Mar. 1, 1940		4.0	12.5	95.1	.5	23	6.7	27	17	
Do	do	Mar. 22, 1940		6.5	11.1	90.4	0	9	6.8	10	26	
Little Sandy River, mouth	OLs 0.1	June 2, 1939	96	27.0	6.5	80.2	1.7	43		20	35	
Do	do	June 6, 1939	115	23.0	7.0	80.5	1.7	43		18	38	
Do	do	June 8, 1939	83	24.0	6.8	79.1	1.5	23		32	36	
Do	do	June 12, 1939	140	21.5	6.9	77.8	2.7	460		1,300	22	
Do	do	June 14, 1939	106	21.0	7.3	81.4	1.3	43		160	34	
Do	do	June 16, 1939	86	22.0	7.2	81.3	1.0	23		57	39	
Do	do	June 20, 1939	196	24.0	6.5	76.3	1.2	4		52	39	
Do	do	June 22, 1929	273	24.5	6.5	76.9	.7	46		100	37	
Do	do	June 26, 1939	98	24.5	6.7	79.5	1.3	9	7.3	55	46	
Do	do	June 28, 1939	91	24.5	6.7	79.3	.9	0	7.2	65	42	
Do	do	June 30, 1939	100	24.0	6.3	73.4	.9	46	7.2	150	39	
Do	do	July 6, 1939	7,880	22.5	5.8	66.6	2.7		7.4	2,500	14	
Do	do	July 10, 1939	279	25.0	6.8	81.3	.9	75	7.4	550	22	
Do	do	July 12, 1939	157	23.5	7.5	87.2	.4	43	7.2	65	32	
Do	do	July 14, 1939	115	24.0	7.2	84.2	.6	4	7.5	50	26	
Do	do	July 18, 1939	86	23.5	7.7	89.8	1.3	110	7.3	30	39	
Do	do	July 20, 1939	557	22.5	7.2	82.3	1.9	1,100	7.2	400	42	
Do	do	July 24, 1939		23.0	7.6	87.2	.8	36	7.2	100	42	
Do	do	July 26, 1939		24.0	7.2	84.5	.7	240	7.2	125	37	
Do	do	July 28, 1939		24.5	7.0	82.5	.7	23	7.2	85	36	
Do	do	Aug. 1, 1939	173	24.0	7.2	83.6	.9	240	7.4	45	46	
Do	do	Aug. 3, 1939	106	24.5	7.3	86.6	.5	23	7.3	40	50	
Do	do	Aug. 7, 1939	88	25.0	7.1	84.2	1.0	75	7.4	75	42	
Do	do	Aug. 9, 1939	83	25.0	7.0	83.4	.9	240	7.3	35	44	

Do	do	Aug. 11, 1939	73	24.5	7.3	86.4	1.1	1,100	7.4	20	47	
Do	do	Aug. 15, 1939	225	24.0	6.6	87.6	1.3	91	7.4	220	36	
Do	do	Aug. 17, 1939	716	14.5	7.1	83.7	.7	93	7.3	50	49	
Do	do	Aug. 21, 1939	225	23.5	7.2	83.5	1.3	93	7.4	880	29	
Do	do	Aug. 23, 1939	111	23.0	7.3	84.3	.9	460	7.4	250	29	
Do	do	Aug. 25, 1939	85	24.0	7.2	84.2	1.0	210	7.6	90	33	
Do	do	Aug. 29, 1939	71	24.0	7.1	83.1	1.2	91	7.4	35	36	
Do	do	Aug. 31, 1939	67	24.5	7.0	82.2	1.5	150	7.3	18	33	
Do	do	Sept. 5, 1939	388	24.0	6.5	75.9	1.3	43	7.4	9	44	
Do	do	Sept. 7, 1939	296	24.0	7.1	83.2	1.0	93	7.3	10	42	
Do	do	Sept. 11, 1939	250	24.0	6.7	78.9	1.2		7.3	12	46	
Do	do	Sept. 13, 1939	236	25.0	7.4	88.6	1.0	230	7.3	7	48	
Do	do	Sept. 15, 1939	227	25.5	6.7	81.1	1.0	390	7.5	6	48	
Do	do	Sept. 19, 1939	200	24.0	7.2	84.1	1.1	230	7.4	8	51	
Do	do	Sept. 21, 1939	361	22.0	7.0	79.2	.7	150	7.2	6	46	
Do	do	Sept. 25, 1939	196	21.5	7.6	85.1	1.2	930	7.5	12	48	
Do	do	Sept. 27, 1939	186	21.5	7.9	88.3	.8	230	7.6	6	49	
Do	do	Sept. 29, 1939	158	22.5	7.5	85.9	.8	240	7.8	5	53	
Do	do	Oct. 3, 1939	108	18.0	8.0	83.9	1.0	430	7.7	11	54	
Do	do	Oct. 5, 1939	90	19.0	8.0	85.3	.8	230	7.6	20	47	
Do	do	Oct. 9, 1939	77	20.5	7.9	87.2	.7	23	7.7	8	50	
Do	do	Oct. 11, 1939	77	20.5	7.7	84.9	.9	430	7.5	15	52	
Do	do	Oct. 13, 1939	67	18.0	7.9	82.6	.9	230	7.9	9	47	
Do	do	Oct. 17, 1939	58	15.5	9.0	89.3	.9	230	7.6	8	43	
Do	do	Oct. 19, 1939	63	15.0	9.0	88.7	.9	240	7.4	12	45	
Do	do	Oct. 23, 1939	60	15.0	8.5	83.4	.8	150	7.6	14	44	
Do	do	Oct. 25, 1939	31	15.5	8.6	85.8	.9	230	7.5	7	41	
Do	do	Oct. 27, 1939	29	17.0	7.9	81.1	1.0	460	7.3	10	46	
Do	do	Oct. 31, 1939	111	11.0	8.1	73.5	.8	91	7.0	75	53	
Do	do	Nov. 2, 1939	77	10.5	9.0	80.2	1.4	3	7.4	17	68	
Do	do	Nov. 6, 1939	75	7.0	9.6	79.3	1.2	24	7.2	8	71	
Do	do	Nov. 8, 1939	73	7.0	9.8	80.8	1.0	15	7.2	12	67	
Do	do	Nov. 10, 1939	75	6.5	9.9	80.3	1.0	24	7.4	12	71	
Do	do	Nov. 14, 1939	58	10.5	10.0	89.6	1.4		7.2	13	65	
Do	do	Nov. 16, 1939	65	11.0	10.5	94.6	1.0	93	7.4	13	53	
Do	do	Nov. 24, 1939	81	6.0	10.1	81.2	1.0	460	7.1	14	38	
Do	do	Nov. 28, 1939	79	7.0	10.6	87.1	1.2	93	7.2	8	44	
Do	do	Nov. 30, 1939	81	5.5	10.4	82.6	.8	240	7.0	13	49	
Do	do	Dec. 4, 1939	81	6.0	10.6	84.9	1.0	93	7.1	15	49	
Do	do	Dec. 8, 1939	75	5.5	10.9	86.3	1.0	240	7.1	13	49	
Do	do	Dec. 12, 1939	75	5.0	11.3	88.3	1.1	43	7.1	8	42	
Do	do	Dec. 14, 1939	81	5.0	11.2	87.8	1.4		7.1	13	45	
Do	do	Dec. 18, 1939	77	4.5	11.4	88.1	.7	23	7.3	9	52	
Do	do	Dec. 20, 1939	85	6.5	11.2	91.0	.9	240		8	40	
Do	do	Dec. 22, 1939	90	4.0	11.6	88.6	.8	58	7.3	8	45	
Do	do	Dec. 27, 1939	94	3.5	12.5	94.1	.8	9	7.0	7	55	
Do	do	Dec. 29, 1939	94	1.5	12.6	89.6	1.1	21	7.2	8	46	
Do	do	Jan. 15, 1940	820	.5	12.5	85.4	1.0	15	7.1	27	54	
Do	do	Jan. 17, 1940	324	.5	13.5	93.8	1.1	9	6.8	90	40	
Do	do	Feb. 20, 1940	3,150	3.5	11.8	88.7	1.3	4	6.9	300	23	

[2] Less tnan one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most popular number per milliliter	pH	Turbidity parts per million	Alkalinity, parts per million	Hardness, parts per million
Little Sandy River, mouth	do	Feb. 26, 1940	518	2.5	12.9	94.4	.7	4	7.1	18	19	
Do	do	Feb. 28, 1940	2,410	3.0	12.9	95.6	.6	24	7.1	45	23	
Do	do	Mar. 5, 1940	2,900	7.5	10.5	87.5	1.0	9	6.7	350	19	
Do	do	Mar. 7, 1940	1,170	5.5	11.3	89.4	.6	9	6.9	85	15	
Do	do	Mar. 11, 1940	423	4.0	12.0	91.4	.4	7	7.0	16	23	
Do	do	Mar. 13, 1940	330	3.5	12.4	93.3	.4	0	7.0	9	26	
Do	do	Mar. 15, 1940	703	3.5	12.4	93.0	.7	9	6.9	14	25	
Do	do	Mar. 19, 1940	667	7.0	11.6	95.2	1.2	1	6.8	150	18	
Do	do	Mar. 21, 1940	550	7.0	11.3	92.5	.4	15	6.9	30	17	
Do	do	Mar. 25, 1940	275	4.0	12.0	91.5	.5	9	6.9	7	23	
Do	do	Mar. 27, 1940	236	4.0	12.6	95.8	.7	4	6.9	8	26	
Do	do	Mar. 29, 1940	234	8.0	11.5	97.0	.2	15	6.8	7	27	
Do	do	Apr. 2, 1940	2,150	10.0	9.9	87.5	1.1	46	6.8	140	14	
Do	do	Apr. 4, 1940	1,150	12.0	9.3	86.0	.8	43	6.8	65	18	
Do	do	Apr. 8, 1940	490	11.5	9.4	85.8	.4	9	6.8	15	19	
Do	do	Apr. 10, 1940	376	10.0	9.6	84.4	.4	0	6.6	7	26	
Tygart Creek, mouth, at Highway bridge.	OTy 1.0	July 11, 1939		24.0	6.8	80.0	.6	240	7.5	75	69	
Do	do	July 13, 1939		25.0	6.6	78.8	.6	23	7.7	45	80	
Do	do	July 19, 1939		22.0	6.4	72.7	.9	23	7.5	75	78	
Do	do	July 25, 1939		22.5	7.1	81.3	.6	43	7.4	40	65	
Do	do	July 31, 1939		23.0	6.4	74.1	1.1	93	7.4	150	72	
Do	do	Aug. 8, 1939		23.0	6.4	74.9	1.3	9	7.5	25	83	
Do	do	Aug. 14, 1939		24.0	6.4	75.0	2.1	15	7.7	30	83	
Do	do	Aug. 22, 1939		22.0	6.7	76.0	.7	8	7.5	65	58	
Do	do	Aug. 28, 1939		22.5	6.7	76.6	1.0	4	7.6	30	85	
Do	do	Sept. 5, 1939		21.5	5.8	65.2	1.0	2	7.4	16	91	
Do	do	Sept. 11, 1939		21.5	5.8	65.5	1.1	2	7.5	14	93	
Do	do	Sept. 19, 1939		20.5	6.4	70.8	.8	4	7.4	8	106	
Do	do	Sept. 25, 1939		17.5	6.7	69.4	.8	2	7.6	12	107	
Do	do	Oct. 3, 1939		15.0	7.2	71.1	1.1	5	7.7	14	106	
Do	do	Oct. 9, 1939		18.0	7.0	73.0	.9	9	7.7	13	92	
Do	do	Oct. 17, 1939		11.5	7.9	71.8	1.1	2	7.5	13	94	
Do	do	Oct. 23, 1939		11.5	7.2	65.9	1.4	2	7.6	10	99	
Do	do	Oct. 31, 1939		10.5	5.6	50.3	1.9	9	7.1	25	73	
Do	do	Nov. 6, 1939		6.0	8.5	67.8	1.6	2	7.4	10	77	
Do	do	Nov. 14, 1939		5.0	8.2	63.9	1.2	1	7.2	8	90	
Do	do	Nov. 20, 1939		8.0	7.0	58.8	2.1	(2)	7.4	12	95	

Do	do	Nov. 28, 1939		5.5	9.1	71.9	1.0	(²)	7.4	23	89	
Do	do	Dec. 4, 1939		6.0	8.8	70.7	1.1	1	6.9	14	90	
Do	do	Dec. 12, 1939		5.5	9.9	78.6	1.3	2	7.5	10	83	
Do	do	Dec. 18, 1939		6.0	10.5	84.4	1.0	1	7.4	13	83	
Do	do	Dec. 26, 1939		3.0	12.0	88.9	1.2	2	7.6	19	83	
Do	do	Jan. 3, 1940		.5	12.4	85.9	1.2	0	7.2	14	85	
Do	do	Jan. 15, 1940		3.0	11.5	85.1	.7	5	7.1	25	84	
Do	do	Feb. 12, 1940		5.5	12.4	98.1	1.3	4	7.4	225	38	
Do	do	Feb. 20, 1940		4.5	12.3	94.6	1.4	4	7.1	260	41	
Do	do	Feb. 26, 1940		3.0	12.6	93.6	.7	4	7.3	17	41	
Do	do	Mar. 5, 1940		8.0	11.0	92.6	1.0	46	7.0	210	32	
Do	do	Mar. 11, 1940		4.5	11.7	90.5	.7	4	7.0	9	45	
Do	do	Mar. 19, 1940		8.0	11.3	95.5	1.1	7	7.1	250	37	
Do	do	Mar. 25, 1940		5.0	11.9	92.7	.8	0	6.9	8	41	
Do	do	Apr. 2, 1940		11.5	9.9	90.2	1.1	46	6.8	110	31	
Do	do	Apr. 8, 1940		13.5	9.0	85.9	.5	2	6.7	10	43	
Lick Creek, above West Union, Ohio	OBrLi 15	Sept. 8, 1939		17.5	7.5	78.1	.8	110	8.0			
Do	do	Oct. 5, 1939		14.0	8.5	82.3	1.1	1,100	7.9			
Do	do	Nov. 2, 1939		5.0	10.6	83.0	.9	73	7.8			
Do	do	Dec. 13, 1939		5.0	10.6	83.1	5.4	230				
Do	do	Jan. 12, 1940		0	12.5	85.4	5.5	240				
Beasley Fork, below West Union, Ohio.	OBrBe 13	Sept. 8, 1939		24.0	6.4	75.6	1.5	93	7.9			
Do	do	Oct. 5, 1939		15.5	10.4	104.0	1.4	39	7.9			
Do	do	Nov. 2, 1939		5.0	12.2	95.6	.9	23	8.0			
Do	do	Dec. 13, 1939		5.5	11.4	90.4	6.6	1,500				
Do	do	Jan. 12, 1940		0	13.2	90.5	.8	240				
Brush Fork, West Union, Ohio	OBr 14	Sept. 8, 1939		17.0	6.8	69.6	2.4	24	7.0			
White Oak Creek, above Georgetown, Ohio.	OWo 11	Aug. 1, 1939		24.5	8.1	95.4	1.1	9				
Do	do	Sept. 8, 1939		24.5	7.0	82.2	1.1	4	7.9			
Do	do	Oct. 5, 1939		17.0	9.1	93.7	1.1	(²)	7.9			
Do	do	Nov. 2, 1939		6.0	12.4	99.0	1.4	9	7.6			
Do	do	Dec. 13, 1939		5.5	12.0	95.3	2.5	1				
Do	do	Jan. 12, 1940		0	13.9	94.9	3.2	1				
White Oak Creek, below Georgetown, Ohio.	OWo 10	Aug. 1, 1939		24.0	7.6	88.7	2.9	43				
Do	do	Sept. 8, 1939		23.5	7.5	86.9	.9	3	7.9			
Do	do	Oct. 5, 1939		17.5	9.6	99.9	1.2	11	7.9			
Do	do	Nov. 2, 1939		7.0	11.4	93.7	1.2	9	7.5			
Do	do	Dec. 13, 1939		6.6	11.9	96.5	.7	4				
Do	do	Jan. 12, 1940		0	13.2	90.2	1.0	5				
Tanners Creek, above Lawrenceburg, Ind.	OTa 0.2	July 14, 1939		24.5	6.0	70.8	1.6	9				
Do	do	July 26, 1939		24.0	6.6	77.4	1.2	24				
Do	do	Aug. 10, 1939		21.0	6.3	70.5	.4	23				
Do	do	Aug. 23, 1939		20.5	5.6	61.1	1.5	150	7.4			
Do	do	Sept. 20, 1939		18.0	5.8	61.1	.8	9	7.5			
Do	do	Oct. 18, 1939		17.5	10.1	105.1	5.3	2	7.7			
Do	do	Nov. 15, 1939		5.0	18.8	146.5	3.3	1	7.6			
Do	do	Dec. 27, 1939		1.0	15.2	106.5	2.4	4	8.0			

² Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results* —Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most popular number per milliliter	pH	Turbidity parts per million	Alkalinity, parts per million	Hardness, parts per million
Tanners Creek, below Lawrenceburg, Ind.	OTa 0.0	July 14, 1939		30.0	0	0	43.6	2,300				
Do	do	July 26, 1939		27.0	0	0	70.0	11,000				
Do	do	Aug. 10, 1939		26.0	0	0	23.0	2,300				
Do	do	Aug. 23, 1939		30.0	0	0	47.2	2,400	7.5			
Do	do	Sept. 20, 1939		27.0	0	0	162.4	7,300	7.1			
Do	do	Oct. 18, 1939		27.0	0	0	68.1	24,000	7.5			
Do	do	Nov. 15, 1939		26.5	0	0	114.5	43,000	7.4			
Do	do	Dec. 27, 1939		30.0	0	0	441.5	360	7.5			
North Fork, Hogan Creek, above Aurora, Ind.	CHNf 0.5	July 14, 1939		26.0	7.7	93.7	3.6	24				
Do	do	July 26, 1939		24.5	6.4	75.5	1.9	24				
Do	do	Aug. 10, 1939		21.0	7.1	79.0	1.5	23				
Do	do	Aug. 23, 1939		21.0	7.5	83.6	2.1	23	7.6			
Do	do	Sept. 20, 1939		17.0	8.6	88.3	.9	46	7.9			
Do	do	Oct. 18, 1939		6.0	11.6	92.9	.3	2	7.9			
Do	do	Nov. 15, 1939		1.5	12.2	87.3	3.5	24	7.8			
Do	do	Dec. 27, 1939		1.0	12.8	89.7	2.3	4	7.9			
South Fork, Hogan Creek, above Aurora, Ind.	OHSf 0.5	July 14, 1939		26.0	6.8	83.1	3.4	110				
Do	do	July 26, 1939		25.5	7.8	94.3	2.8	240				
Do	do	Aug. 10, 1939		23.5	5.8	68.0	1.9	460				
Do	do	Aug. 23, 1939		21.5	5.9	65.8	5.4	43	7.6			
Do	do	Sept. 20, 1939		19.0	4.2	44.9	3.0	36	7.5			
Do	do	Oct. 18, 1939		8.0	5.5	46.3	2.7	4	7.5			
Do	do	Nov. 15, 1939		3.5	7.1	53.6	6.6	1	7.5			
Do	do	Dec. 27, 1939		.5	10.8	75.2	5.6	240	7.8			
Hogan Creek, below Aurora, Ind	OH 0.0	July 14, 1939		27.0	6.8	84.6	2.4	460				
Do	do	July 26, 1939		25.5	5.6	67.7	2.6	230				
Do	do	Aug. 10, 1939		25.0	7.0	84.1	2.0	460				
Do	do	Aug. 23, 1939		25.5	6.1	73.0	1.7	240	7.5			
Do	do	Sept. 20, 1939		23.5	6.5	75.5	1.8	23	7.3			
Do	do	Oct. 18, 1939		15.0	7.2	71.4	1.7	1,100	7.5			
Do	do	Nov. 15, 1939		6.5	8.7	70.5	3.1	2,400	7.5			
Do	do	Dec. 27, 1939		3.0	11.6	85.8	4.1	91	7.5			
Laughery Creek, above Batesville, Ind.	OLa 40.0	July 14, 1939		28.5	4.5	57.8	6.4	240				
Do	do	July 26, 1939		27.5	7.8	97.9	6.1	930				
Do	do	Aug. 10, 1939		25.0	1.6	19.6	10.7	1				

Laughery Creek, below Batesville, Ind.	OLa 39.7	July 14, 1939		28.0	10.2	129.3	5.1	2,400				
Do	do	July 26, 1939		26.5	10.0	122.9	6.5	430				
Do	do	Aug. 10, 1939		25.0	8.8	104.9	6.7	930				
Laughery Creek, above Osgood, Ind	OLa 30.0	July 14, 1939		26.5	8.5	104.8	1.8	4				
Do	do	July 26, 1939		24.5	6.3	74.3	1.9	24				
Do	do	Aug. 10, 1939		23.5	5.7	66.3	2.3	23				
Laughery Creek, below Osgood, Ind	OTa 29.7	July 14, 1939		26.0	7.2	87.8	2.5	43				
Do	do	July 26, 1939		25.0	7.6	90.3	3.8	46				
Do	do	Aug. 10, 1939		23.0	5.7	65.7	1.3	9				
North Fork Cedar Creek, prison farm, Louisville, Ky.	OHaCNf 8.8	July 29, 1940	(2)	29.0	5.7	73.7	25.5	24,000	7.2	70	141	
Do	do	July 31, 1940	(2)	28.5	0	0	38.6	4,300	7.1	20	80	
Do	do	Aug. 2, 1940	(2)	26.0	0	0	20.4	230	7.2	35	116	136
Harrods Creek, mouth	OHa 0.0	Aug. 1, 1940		29.5	6.1	79.5	1.9	93	7.7	12	86	
Do	do	Aug. 3, 1940		28.0	4.6	57.8	1.5	23	7.6	16	95	
Do	do	Aug. 7, 1940		27.0	2.7	33.0	1.3	93	7.6	1,700	120	99
Do	do	Aug. 9, 1940		27.0	3.4	42.0	1.1	93	7.7	14	118	
Do	do	Oct. 25, 1940		16.0	6.3	63.1	1.1	3	7.5	15	72	148
Do	do	Oct. 26, 1940		None	6.4		1.1	2	7.5	15	72	
Do	do	Jan. 27, 1941		5.5	12.2	96.8	2.2	14	7.9	38	154	
Do	do	Jan. 28, 1941		5.0	12.5	97.9	.7	23	7.9	35	173	
Do	do	Jan. 29, 1941		4.0	12.6	96.3	.9	4	7.9	31	174	140
Do	do	Jan. 30, 1941		3.0	12.6	93.5	1.2	24	8.0	33	176	
Do	do	Jan. 31, 1941		3.5	12.7	95.6	.8	9	7.9	14	177	
Goose Creek, 1 mile below Anchorage, Ky.	OGo 3.9	July 29, 1940	(2)	26.5	0	0	59.4	11,000	7.1	100	158	
Do	do	July 31, 1940	(2)	25.0	0	0	53.8	240,000	7.2	70	202	
Do	do	Aug. 2, 1940	(2)	21.0	0	0	42.8	93,000	7.3	70	204	148
Goose Creek, mouth	OGo 0.0	Aug. 1, 1940		29.0	3.0	38.7	4.5	230	7.3	40	108	
Do	do	Aug. 3, 1940		28.0	3.6	45.5	2.4	36	7.3	72	95	
Do	do	Aug. 7, 1940		22.0	2.9	32.8	10.0	2,400	7.5	25	66	63
Do	do	Aug. 9, 1940		23.5	3.1	35.9	3.7	930	7.5	75	86	
Do	do	Oct. 25, 1940		15.5	5.0	50.0	2.2	93	7.5	55	112	126
Do	do	Oct. 26, 1940		16.5	4.4	44.7	2.0	43	7.4	55	120	
Do	do	Jan. 27, 1941		5.0	10.4	80.9	4.1	93	7.8	25	171	
Do	do	Jan. 28, 1941		4.0	11.1	84.3	2.5	43	7.8	13	179	
Do	do	Jan. 29, 1941		3.5	11.5	86.5	1.8	150	7.8	12	181	145
Do	do	Jan. 30, 1941		3.5	12.3	92.6	3.3	240	7.8	118	179	
Do	do	Jan. 31, 1941		3.0	11.7	86.6	1.9	75	7.8	12	181	
Bear Grass Creek, Lexington Rd	OBg 2.0	July 29, 1940	4	26.0	0	0	28.8	230	7.3	20	158	
Do	do	July 31, 1940	[1] 5	24.0	0	0	28.0	24,000	6.8	130	58	
Do	do	Aug. 2, 1940	(2)	22.5	0	0	10.4	4,600	7.1	35	134	
Bear Grass Creek, mouth, Highway Bridge.	OBg 0.0	Aug. 1, 1940		28.0	2.0	25.9	9.5	11,000	7.1	57	96	
Do	do	Aug. 3, 1940		28.0	0	0	11.7	9,300	7.1	32	130	
Do	do	Aug. 7, 1940		25.5	0	0	28.2	1,100,000	7.1	80	118	118
Do	do	Aug. 9, 1940		27.0	1.8	22.2	12.0	75,000	7.2	13	106	
Do	do	Oct. 25, 1940		17.0	0	0	44.0	46,000	7.3	35	182	180
Do	do	Oct. 26, 1940		18.0	0	0	58.4	46,000	7.3	35	224	

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature	Dissolved oxygen		5-day bio-chemical oxygen demand, parts per million	Coliforms, most popular number per milliliter	pH	Turbidity parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Bear Grass Ceerk, mouth, Highway Bridge.	OBg 0.0	Jan. 27, 1941		5.5	9.8	77.2	5.1	430	7.7	30	175	
Do	do	Jan. 28, 1941		5.0	11.3	88.0	8.9	430	7.7	41	184	
Do	do	Jan. 29, 1941		3.5	11.5	86.7	5.8	460	7.7	25	186	189
Do	do	Jan. 30, 1941		4.5	11.0	85.0	9.4	1,500	7.6	105	196	
Do	do	Jan. 31, 1941		4.5	11.3	87.4	9.0	2,400	7.7	90	203	
Sanders Spring, Fort Knox intake	OOcS 6.0	Oct. 25, 1941		None	10.2		.4	3	7.7	3	231	121
Do	do	Oct. 26, 1941		16.0	10.7	107.3	.8	1	7.7	3	224	
Otter Creek, near Fort Knox intake	OOc 5.4	Oct. 21, 1941		13.0	10.2	96.0	2.7	3	7.7	5	204	
Do	do	Oct. 22, 1941		14.0	9.4	91.0	1.9	2	7.8	8	203	
Do	do	Oct. 23, 1941		16.0	9.4	94.8	2.2	2	7.8	8	204	
Do	do	Oct. 24, 1941		16.0	8.2	82.0	1.4	2	7.7	8	206	197
Otter Creek, Tip Top, Ky	OOc 3.4	Aug. 1, 1941	1	24.0	8.5	100.0	1.3	240	7.8	20	170	
Do	do	Aug. 5, 1941	50	23.0	8.2	94.7	3.3	23	7.7	15	172	164
Do	do	Aug. 6, 1941	50	25.0	7.9	91.9	2.9	240	7.7	20	174	
Otter Creek, just above mouth	OOc 0.0	Oct. 19, 1941		19.0	9.3	99.8	1.8	75	7.7	13	135	
Big Indian Creek, water works, intake, Corydon, Ind.	OBi 19	Aug. 1, 1941		28.5	6.5	83.4	1.4	9	7.7	18	150	
Do	do	Aug. 7, 1941		27.0	5.9	73.2	1.5	43	7.7	13	156	
Do	do	Aug. 9, 1941		24.0	6.1	71.4	1.8	9	7.5	12	161	
Big Indian Creek, below sewage plant, Corydon, Ind.	OBi 17	Aug. 1, 1941		28.0	7.2	91.2	7.5	4,600	7.7	30	159	
Do	do	Aug. 7, 1941		27.0	4.8	59.4	9.1	46,000	7.7	30	142	132
Do	do	Aug. 9, 1941		21.5	2.0	22.7	4.2	21,000	7.5	10	176	
North Fork Blue River, 2¾ miles below Salem, Ind.	OBBlNf 59	Oct. 23, 1941	(2)	13.0	7.3	68.7	2.2	23	7.7	10	234	208
Do	do	Oct. 28, 1941	(2)	16.0	4.8	47.9	2.3	93	7.7	12	242	
Do	do	Oct. 31, 1941	(2)	11.0	7.0	63.2	3.8	43	7.6	13	240	
Big Blue River, mouth	OBBl 0.1	Aug. 15, 1941		27.0	8.5	105.0	2.9	23	8.4	12	80	
Do	do	Aug. 19, 1941		27.5	6.9	86.4	2.6	21	7.7	35	66	
Do	do	Aug. 20, 1941		25.0	7.3	86.6	2.3	46	7.6	28	65	115
Do	do	Aug. 23, 1941		24.5	8.2	97.3	1.3	240	7.7	15	62	
Do	do	Feb. 12, 1941		5.5	13.2	104.6	.8	4	8.0	12	159	
Do	do	Feb. 14, 1941		4.5	11.9	92.0	1.4	1	7.8	15	150	174
Cypress Creek, 1 mile below Booneville, Ind.	OCy 1.0	Oct. 22, 1940	1	13.5	0	0	23.0	360	7.5	10	246	
Do	do	Oct. 25, 1940	1	18.0	0	0	15.0	9,300	7.4	10	275	660
Do	do	Oct. 30, 1940	1	13.0	0	0	68.8	24,000	7.0	30	199	

Lost Creek, below sewage outfall, Morganfield, Ky.	OL 9.8	Oct. 28, 1940	(2)	17.0	6.3	64.5	10.0	7,500	7.5	220	258	
Do	do	Oct. 31, 1940	(2)	8.5	7.0	59.7	5.2	2,400	7.6	70	256	640
Do	do	Nov. 5, 1940	1	15.5	6.3	62.7	6.6	4,300	7.6	75	234	
Eldorado drainage ditch, ½ mile below Eldorado, Ill.	OSa	Aug. 23, 1940	(2)	32.0	0	0	13.2	23,000	6.9	125	256	232
Do	do	Aug. 26, 1940	(2)	33.0	0	0	40.0	24,000	7.4	88	444	
Do	do	Aug. 27, 1940	2	None			42.2	36	2.8	550		
Tributary to Middle Fork Saline, below Wasson, Ill.	OSaMfT	Aug. 22, 1940	1	21.0	7.8	86.3	2.5	(2)	3.0	5		
Do	do	Aug. 23, 1940	1	23.0	8.0	91.7	2.1	1	3.3	5		1,765
Do	do	Aug. 26, 1940	1	27.5	1.0	12.5	2.1	(2)	6.6	5		
Middle Fork Saline River, water works, Harrisburg, Ill.	OSaMf	Aug. 23, 1940	1	27.5	6.0	74.8	1.8	2	3.4	5		1,075
Do	do	Aug. 26, 1940	1	30.0	2.2	28.2	3.2	(2)	2.9	5		
Do	do	Aug. 27, 1940	1	26.0	1.0	11.2	2.5	(2)	2.9	10		
Middle Fork Saline River, Pankey Fork.	OSaMf	Aug. 23, 1940	1	25.5	5.5	66.7	10.0	43	4.7	15		192
Do	do	Aug. 26, 1940	1	26.0	0	0	5.5	4	4.4	10		
Do	do	Aug. 27, 1940	1	27.0	0	0	15.8	(2)	3.9	15		
South Fork Saline River, ¾ mile above junction with Middle Fork.	OSaSf	Aug. 22, 1940	9	25.0	7.6	90.7	2.1	240	6.7	320	35	40
Do	do	Aug. 23, 1940	3	26.5	7.8	95.8	2.2	23	7.1	190	37	
Do	do	Aug. 26, 1940	1	29.0	7.3	94.0	1.9	23	7.6	120	53	
Saline River, Equality, Ill	OSa	Aug. 23, 1940	10	24.0	7.7	90.5	2.2	11.	6.9	5	35	137
Do	do	Aug. 26, 1940	4	26.0	8.0	97.6	1.8	43	7.1	5	40	
Do	do	Aug. 27, 1940	5	27.0	7.5	93.4	2.0	4	7.0	10	37	
Saline River mouth	OSa 0.1	Sept. 10, 1940		24.5	7.5	88.5	1.8	9	7.7	55	92	
Do	do	Sept. 12, 1940		23.0	7.2	82.7	1.8	2	7.9	47	92	89
Do	do	Sept. 16, 1940		22.0	8.9	100.6	1.8	2	7.9	18	83	
Do	do	Sept. 18, 1940		22.5	9.2	105.0	1.4	9	8.3	18	85	
Do	do	Nov. 5, 1940		15.5	8.2	81.9	1.7	8	7.7	15	91	149
Do	do	Nov. 7, 1940		13.5	8.9	85.3	2.2	9	7.7	15	84	
Do	do	Nov. 8, 1940		13.5	8.7	83.0	1.6	4	7.7	15	90	
Do	do	Feb. 26, 1941		2.0	13.3	96.2	3.5	9	7.4	13	98	148
Do	do	Feb. 28, 1941		1.5	13.7	97.4	2.0	2	7.5	12	95	
Tradewater River, above Dawson Springs, Ky.	OTr 87.5	Oct. 29, 1940	(2)	19.5	2.3	24.4	4.6	43	6.7	25	36	42
Do	do	Nov. 1, 1940	(2)	15.5	2.5	25.0	2.5	1	6.8	15	50	
Do	do	Nov. 6, 1940	(2)	8.0	2.3	19.1	1.0	(2)	6.7	25	46	
Tradewater River, below Dawson Springs, Ky.	OTr 86	Oct. 29, 1940	(2)	19.5	0	0	235.0	93,000	6.7	140	182	96
Do	do	Nov. 1, 1940	(2)	15.5	0	0	95.0	75,000	6.7	80	114	
Do	do	Nov. 6, 1940	(2)	7.5	0	0	66.0	240,000	6.9	60	150	
Greasy Creek Bridge, below Earlington, Ky.	OTrClGr 63	Nov. 12, 1940	1	10.0	7.4	65.1	.1 [1] 6.1	(2)	3.1	10		
Do	do	Nov. 14, 1940	(2)	5.5	10.7	84.6	2.6 [1] 7.7	(2)	3.4	10		
Do	do	Nov. 18, 1940	(2)	10.5	9.2	82.3	12.7 [1] 13.2	(2)	3.5	10		7,200

[2] Less than one.

TABLE M-7.—*Minor tributary basins: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Tradewater River, water works, Providence, Ky.	OTr 41	Oct. 28, 1940	(2)	23.5	6.5	75.6	1.7	2	7.1	20	88	
Do	do	Oct. 31, 1940	(2)	15.0	6.5	63.8	2.7	2	7.1	50	90	
Do	do	Nov. 5, 1940	(2)	12.5	7.8	72.5	2.4	2	7.2	30	76	102
Owens Creek, below sewage plant, Providence, Ky.	OTrO 43	Oct. 28, 1940	2	24.5	7.9	93.5	2.8; [1]0.7	1	3.6	130		
Do	do	Oct. 31, 1940	(2)	15.0	2.0	19.3	131.0	2,300	7.1	150	238	
Do	do	Nov. 5, 1940	(2)	12.5	4.6	42.6	16.0; [1]15.5	23	5.7	130	16	820
Cypress Creek, below sewage plant, Sturgis, Ky.	OTrCy 8	Oct. 28, 1940	(2)	18.0	0	0	99.0	4,300	7.4	220	312	
Do	do	Oct. 31, 1940	(2)	9.5	0	0	34.0	24,000	7.4	240	240	770
Do	do	Nov. 5, 1940	2	15.5	4.4	43.8	12.9	2,300	6.8	170	62	
Tradewater River, waterworks intake, Sturgis, Ky.	OTr 6	Oct. 28, 1940	2	18.5	4.6	48.6	1.1	4	7.3	5	84	
Do	do	Oct. 31, 1940	3	9.5	4.0	34.6	4.9	9	7.2	5	82	
Do	do	Nov. 5, 1940	4	16.5	4.5	45.4	2.1	4	7.1	15	80	134
Tradewater River, mouth	OTr 0.2	Sept. 10, 1940	2	24.0	4.6	53.9	1.5	9	7.5	50	68	
Do	do	Sept. 12, 1940	1	22.5	8.6	98.8	1.3	4	7.8	23	68	85
Do	do	Sept. 16, 1940	1	21.5	8.7	97.8	1.6	4	7.9	27	67	
Do	do	Sept. 18, 1940	1	22.0	9.2	103.8	1.1	2	8.0	15	68	
Do	do	Nov. 5, 1940	1	16.0	8.9	89.4	1.9	9	7.8	18	72	148
Do	do	Nov. 7, 1940	1	14.0	10.3	98.9	1.8	2	7.7	13	60	
Do	do	Nov. 8, 1940	1	13.5	10.2	97.5	1.7	24	7.8	12	60	
Do	do	Feb. 26, 1941	151	2.5	12.9	94.6	2.3	4	7.0	12	38	135
Do	do	Feb. 28, 1941	144	1.5	13.3	94.6	1.0	1	7.0	5	42	
Crooked Creek, below sewage, Marion, Ky.	OCr 9.8	Oct. 28, 1940	(2)	21.5	1.1	12.7	23.0	4,300	7.5	15	182	
Do	do	Oct. 31, 1940	(2)	11.5	2.7	24.6	14.4	2,300	7.2	13	158	
Do	do	Nov. 5, 1940	(2)	15.5	6.9	68.9	11.6	2,400	7.3	260	62	88
Town Branch, below sewage, Marion, Ky.	OCrT 9.8	Oct. 28, 1940	(2)	19.5	1.8	19.5	14.2	2,400	6.9	5	72	
Do	do	Oct. 31, 1940	(2)	11.5	2.0	18.6	12.6	2,400	7.0	70	256	640
Do	do	Nov. 5, 1940	1	16.5	0	0	25.8	46,000	7.2	35	170	170
Little Cache River, 1 mile below Anna, Ill.	OLCa 40	Aug. 22, 1940	2	20.0	5.5	60.2	2.1	430	7.3	5	120	127

[1] Seeded and neutralized

[2] Less than one.

TABLE M-7A.—*Minor tributary basins: Laboratory data—Acid stream results*

Stream	Sampling point	Month, 1940	Number of samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Chartiers Creek, mile 3 below Pittsburgh.	Below Washington, Pa., mile 34	October	3	6.1			461(2)		280.0
	Below Houston, Pa., mile 26	do	3	6.0	33(1)		57(1)	16.0(2)	90.0
	Below Canonsburg, Pa., mile 23	do	3	4.4	127(2)		283(2)	40.0(2)	131.0(2)
		November	2	6.3				17.5(1)	55.0
	Below Morganza, Pa., mile 21	October	3	6.1			321(1)	7.0(1)	40.0
		November	2	6.3				12.5(1)	31.0
Miller Run (tributary of Chartiers Creek).	Above Cecil, Pa., mile 16.5	October	4	3.0	622	1,206(1)	1,854	360.0	1,190.0
		November	3	5.1	120(2)		1,399(2)	325.0(2)	415.0
		December	2	6.0			89(1)	16.0(1)	39.0
	Below Cecil, Pa., mile 15.5	October	4	3.0	624	1,022(1)	1,621	183.0	1,390.0
		November	3	5.6	25(2)		675	290.0(2)	384.0
		December	2	6.1			316(1)	80.0(1)	91.0
Robinson Run (tributary of Chartiers Creek).	Below Midway, Pa., mile 21.5	October	4	3.1	222	333(1)	275	1.0	67.0
		November	2	4.5	68		104		13.0
		December	2	4.6(1)	32(1)		60(1)		9.0(1)
	Above McDonald, Pa., mile 19	October	4	2.7	689	833(1)	870	62.0	198.0
		November	2	3.4	244		375	34.0	135.0
		December	2	4.3	115		168	24.0	58.0
	Below McDonald, Pa., mile 17.5	October	4	2.9	412	652(1)	614	28.0	129.0
		November	2	4.0	186		297	19.0	77.0
		December	2	4.4	114		156	20.0	73.0
	Above Oakdale, Pa., mile 15.5	October	4	3.0	429	538(1)	544	28.0	90.0
		November	3	3.9	153		205	20.0	77.0
		December	2	3.8	127		195	17.0	57.0
	Below Oakdale, Pa., mile 14.5	October	4	2.9	410	559(1)	504	8.0	69.0
		November	3	3.6	171		222	8.0	68.0
		December	2	3.1	206		584	10.0	51.0
North Robinson Run (tributary of Chartiers Creek).	Above Oakldale, Pa., mile 15.5	October	4	2.8	449	584(1)	534	1.6	79.0
		November	3	3.3	195		238	5.2	45.0
		December	2	2.9	283		369	4.2	52.0
Chartiers Creek, mile 3 below Pittsburgh.	Above Carnegie, Pa., mile 8.5	October	4	3.5	192	258(1)	312	53.0	181.0
		November	3	5.5	17(2)		158(2)	24.0	101.0
		December	2	6.1				8.0	30.0
	Below Carnegie, Pa., mile 6.5	October	4	3.5	211	316(1)	314	42.0	177.0
		November	3	5.4	30(2)		110(2)	11.0	69.0
		December	2	5.7			58(1)	5.0	23.0

TABLE M-7A.—*Minor tributary basins: Laboratory data—Acid stream results*—Continued

Stream	Sampling point	Month, 1940	Number of samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Raccoon Creek, mile 29.6 below Pittsburgh.	Above Burgettstown, Pa., mile 32.5.	October	4	2.8	879	1,964(1)	1,985	121.0	368.0
		November	2	3.7	311		818	100.0	280.0
		December	2	5.1	174(1)		205	32.0	132.0
	Below Burgettstown, Pa., mile 31.5.	October	4	2.7	640	918(1)	1,031	66.0	277.0
		November	2	3.4	291		558	60.0	220.0
		December	2	4.3	160		248	32.0	112.0
	Mouth, mile 0.5	November	3	4.9(2)	15(2)		40(2)	2.8(2)	13.0
		December	3	5.8(2)			12(2)		4.0
Harmon Creek, mile 66.7 below Pittsburgh.	Mouth, West Virginia, rout 2, mile 0.2.	November	3	2.8	244		336	24.0	80.0
		December	3	2.6	314		415	24.0	59.0
Piney Fork of Short Creek, mile 81.3 below Pittsburgh.	Below Piney Fork, Ohio, mile 11	November	3	4.9(1)	85(1)		151(1)	6.0(1)	56.0(1)
Wheeling Creek, mile 90.2 below Pittsburgh.	Above Barton, Ohio, mile 10.7	October	2	3.4	87		107	7.0	26.0
	Below Barton, Ohio, mile 9.2	September	1	4.7	49	185	161	57.0	72.0
		October	2	3.4	147		174	7.0	43.0
Little Muskingum River, mile 168.3 below Pittsburgh.	Mouth, mile 0.1	August	5	5.6(2)		10(2)	6(2)		.4
		September	5	5.2(3)	4(1)	9(3)	5(3)		.4
Duck Creek, mile 170.6 below Pittsburgh.	Mouth, mile 0.2	August	11	5.9(1)		9(1)	3(1)		
		September	5	5.2(1)		8(1)	4(1)		.1(1)

NOTE.—Figures in parentheses indicate number acid samples used in computing averages as shown.

ALLEGHENY RIVER BASIN

CONTENTS

	Page
Contents	303
Syllabus and conclusions	305
Description	307
Presentation of field data	309
Presentation of laboratory data	313
Hydrometric data	317
Discussion	321

LIST OF TABLES

A–1.—Cost estimates of remedial measures	307
A–2.—Surface water supplies	309
A–3.—Sources of pollution	310
A–4.—Industrial wastes	312
A–5.—Selected laboratory data	314
A–5a.—Selected laboratory data (chemical results)	316
A–6.—Monthly mean summer flows	319
A–7.—Summary of laboratory results	324
A–7a.—Summary of laboratory results on acid streams	350

LIST OF FIGURES

A–1. Map—Sources of pollution	305
A–2. Chart—Sources of pollution and selected laboratory data	312
A–3. Map—Coliform results	316
A–4. Map—Dissolved oxygen results	316
A–5. Map—Biochemical oxygen demand results	316
A–5a. Map—Biochemical oxygen demand results (southern portion of basin)	316
A–5b. Map—pH results	316
A–6. Chart—Summer low flow frequency curve	318

90035—44—pt. 2——11

Fig. A-1

Fig. A-1

ALLEGHENY BASIN

SOURCES OF POLLUTION

ALLEGHENY RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Allegheny River drains 11,730 square miles in western Pennsylvania and New York and joins the Monongahela River at Pittsburgh to form the Ohio River. The southern part of the basin is an important coal-mining area and the streams there are polluted by acid mine drainage. The Kiskiminetas is the most strongly acid large stream in the Ohio Basin. A major portion of the sewage and industrial wastes in the basin enters the Allegheny in the vicinity of Pittsburgh. The Clarion River is grossly polluted by industrial wastes and greatly improved treatment techniques will be required to abate the pollution. The larger communities depend generally on surface water for municipal supplies and a number of these, particularly in the vicinity of Pittsburgh, are seriously affected by acid mine drainage, untreated sewage, and industrial wastes. Considerable progress has been made toward pollution abatement in streams not subject to acid pollution and, in general, these streams are relatively clean.

A program of municipal and industrial waste treatment is outlined which, together with a basin-wide program of mine sealing supplemented by low-flow regulation incidental to flood-control operations at reservoirs already built or authorized by the Congress, seems to offer the most practicable method of pollution abatement.

CONCLUSIONS

(1) Of 225 public water supplies, 91, including those serving most of the larger communities, are from surface sources.

(2) Sewage from about 920,000 people, industrial wastes equivalent in oxygen demand to sewage from an additional 680,000 people, and about 375,000 tons of mine acid per year enter the streams of the basin. About 18 percent of the sewage is treated.

(3) Laboratory data indicate that the major pollution problems are due to acid rather than to organic wastes although organic wastes cause gross pollution in a number of streams not affected by acid.

(4) Mine sealing has reduced the original acid load by about 8 percent from 405,000 to 375,000 tons (to phenolphthalein—hot) per year, and although the present load throughout the Allegheny Basin is only about 32 tons per square mile per year, the tributary Kiskiminetas Basin receives 164 tons of acid per square mile per year, or an intensity greater than the Monongahela or Youghiogheny, the next most strongly acid streams.

(5) A program for acid control including mine sealing supplemented by flow regulation is outlined in the section of the report on Acid Mine

Drainage. Expenditures to date for mine sealing in the basin are estimated at $510,000. The next step in the mine sealing program is completion of sealing of mining areas not connected to active ventilation systems at mines where sealing costs will not exceed $10 per ton of acid sealed per year. The total estimated cost of this program in the Allegheny River Basin is $1,460,000.

(6) Acid conditions can be further improved and mine sealing supplemented by flow regulation from storage of at least 210,000 acre-feet in the Allegheny River Basin. This storage could be provided incidental to or in conjunction with flood control in reservoirs already built or authorized by the Congress.

(7) The problem of municipal sewage treatment at Pittsburgh is discussed in the section of the report on the main Ohio River. Low-flow regulation from reservoirs in the Allegheny River Basin will be of value in reducing treatment costs, notably at Pittsburgh and Cincinnati.

(8) Primary sewage treatment should be adequate at cities on the Allegheny River with the exception of Olean, N. Y. (which now has primary treatment), and Coudersport, Pa. Effluents from existing and suggested plants near water intakes, notably those on the lower 30 miles of the Allegheny, should be chlorinated to reduce bacterial loadings on the water plants.

(9) Justification for treatment and the degree of treatment of sewage and organic industrial wastes in many cases is dependent upon the status of mine-acid reduction measures. The situation varies with the degree of acidity of the stream and the amount of organic pollution discharged. At some places the need for waste treatment is urgent at present, and at others the first expenditures of public funds can be made to best advantage toward furthering the acid-reduction program. In general, cost estimates presented apply to a comprehensive program that will be justified in parallel with extensive acid-control measures.

(10) Secondary treatment is indicated at six communities in addition to Coudersport, the largest ones being Bradford and Du Bois. All of these communities are located on alkaline streams subject to extremely low flows.

(11) Additions or improvements to existing sewage-treatment plants are indicated at seven places, the largest ones being Jamestown and Olean, N. Y. At Jamestown the necessary degree of treatment depends to some extent on the method of operation of the dam at the outlet at Lake Chautauqua.

(12) Industrial-waste pollution is particularly severe along the Clarion River. Any major improvement in conditions there will require the development of better waste-treatment techniques if plant operations continue at the present level.

(13) Cost estimates of a suggested program of sewage and industrial waste treatment are summarized from table A–1 as follows:

Treatment	Capital cost	Annual cost
Existing	$5,460,000	$410,000
Suggested additional	10,680,000	1,155,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual cost
Primary, all places	$10, 010, 000	$1, 065, 000
Secondary, all places	13, 880, 000	1, 545, 000

TABLE A-1.—*Allegheny River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	22	19	164, 300	$5, 460, 000	$310, 000	$100, 000	$410, 000
Suggested minimum correction:							
Sewage treatment plants	86	7	712, 200	6, 350, 000	450, 000	305, 000	755, 000
Required interceptors				3, 670, 000	170, 000		170, 000
Independent industrial waste correction				660, 000	90, 000	140, 000	230, 000
Total				10, 680, 000	710, 000	445, 000	1, 155, 000
Comparative cost:							
Primary treatment, all waste				10, 010, 000	660, 000	405, 000	1, 065, 000
Secondary treatment, all waste				13, 880, 000	930, 000	615, 000	1, 545, 000
As suggested				10, 680, 000	710, 000	445, 000	1, 155, 000

NOTE.—Costs shown above do not include the cost of interceptors or treatment works for the city of Pittsburgh or its suburbs whose wastes would probably be treated at a plant along the Ohio River.

DESCRIPTION

The Allegheny River drains 11,730 square miles, of which 9,775 are in western Pennsylvania and 1,955 are in southwestern New York. The area is, for the most part, hilly or mountainous with steep slopes rising several hundred feet above the narrow stream valleys. In the northern and western portions of the basin, which have been glaciated, the topography is less rugged. The main stream rises in Potter County, Pa., and flows in a northwesterly direction into New York, where after flowing west for about 30 miles, it turns southwest and flows back into Pennsylvania. The Allegheny River, about 325 miles long, joins the Monongahela River at Pittsburgh, Pa., to form the Ohio River.

The principal tributaries of the Allegheny River are:

Tributary stream	Miles above mouth	Drainage area (square miles)
Kiskiminetas River	30. 2	1, 892
Mahoning Creek	56. 2	417
Red Bank Creek	64. 9	586
Clarion River	86. 1	1, 232
French Creek	126. 6	1, 246
Oil Creek	134. 1	340
Tionesta Creek	154. 2	485
Conewango Creek	192. 0	898

The Kiskiminetas Basin is an important bituminous coal mining area and smaller amounts are mined in the Crooked Creek, Cowanshannock Creek, Mahoning Creek, Red Bank Creek, and Clarion River Basins. Although coal underlies much of the area farther north, it is not of great economic importance. Oil is found in the northern part of the basin. Production in the Oil Creek area, the first developed oil field in the country, is decreasing and most of the oil comes from the newer fields to the east. Although almost all of the virgin forests which originally covered about 90 percent of the basin are gone, a large part of the basin is covered with second-growth timber. The more level lands in the glaciated portion of the basin support a stable and prosperous agriculture.

The steel industry in the basin is concentrated around Pittsburgh and at Johnstown, which is also the center of the coal producing area of the Kiskiminetas Basin. The greatest concentrations of population are at these two places. The populations of the basin and its larger cities, excluding the city of Pittsburgh, are shown below:

	Populations			
	1910	1920	1930	1940
Principal cities:				
Johnstown, Pa.	55, 482	67, 327	66, 993	66, 668
Jamestown, N. Y.	31, 297	38, 917	45, 155	42, 638
New Kensington, Pa.	7, 707	11, 987	16, 762	24, 055
Olean, N. Y.	14, 743	20, 506	21, 790	21, 506
Oil City, Pa.	15, 657	21, 274	22, 075	20, 379
Meadville, Pa.	12, 780	14, 568	16, 698	18, 919
Bradford, Pa.	14, 544	15, 525	19, 306	17, 691
Entire basin:				
Rural	654, 456	659, 607	666, 109	713, 148
Urban	365, 270	471, 689	527, 388	523, 546
Total	1, 019, 726	1, 131, 296	1, 193, 497	1, 236, 694

Water uses.—The lower 70 miles of the Allegheny River have been improved for navigation by eight low-lift locks and dams which, with backwater from the Emsworth Dam on the Ohio River, provide a navigable depth of 9 feet. A considerable amount of coal, coke, sand, gravel, and limestone moves on this waterway. One hydroelectric project has been built by private interests, the Piney project, on the Clarion River.

Construction of four flood-control reservoirs has been virtually completed by the Corps of Engineers. These are on Tionesta Creek, Mahoning Creek, Crooked Creek, and Loyalhanna Creek and are part of a system of reservoirs on the Allegheny and Monongahela Rivers and their tributaries intended primarily for the protection of the Pittsburgh metropolitan area. In addition to serving this purpose, it would be physically possible to utilize a portion of their capacity to increase stream flow in the Allegheny and in the tributary streams below the reservoirs during low-flow periods. Four additional reservoirs have been authorized by the Congress for flood control. The largest one would be on the Allegheny River above Warren, Pa., and has been planned to include storage for low-flow regulation.

The cleaner streams in the rather sparsely populated mountainous section north of the mining area are used extensively for recreation. A considerable part of the land in this section is in State forests.

Chautauqua Lake, Conneaut Lake, and other smaller lakes in the basin also are widely used for recreation.

PRESENTATION OF FIELD DATA

Figure A–1 shows the location and magnitude of the more important sources of pollution in the basin. Figure A–2 shows similar data and, in addition, the location of water supply intakes from polluted streams and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Of the 225 public water supplies in the Allegheny River Basin, which serve about 1,545,000 people,[1] 91 are from surface sources. Only 21 of these are from polluted streams, the other 70 being from impounding reservoirs or small streams draining rural areas, but the 21 supplies include most of the largest ones. Table A–2 shows data on the surface water supplies of the basin.

TABLE A–2.—*Allegheny River Basin: Surface water supplies*

Supply	Source	Mile [1]	Treatment [2 3]	Population served [4]	Consumption, million gallons per day
	Supplies below community sewer outfalls				
Pennsylvania:					
Pittsburgh	Allegheny River	8.0	FD	[4] 600,000	80.30
Pennsylvania Water Co.	do	8.5	FD	[4] 167,200	11.00
Fox Chapel	do	10.0	FD	3,500	.14
Oakmont	do	12.8	FD	14,500	2.50
New Kensington	do	21.0	FD	35,000	3.60
Tarentum	do	21.7	LD	13,000	.90
Brackenridge	do	22.5	FD	6,300	.80
Natrona	do	24.6	FD	12,000	.47
Freeport	do	29.3	FD	3,300	.35
Cadogan	do	38.5	FD	700	.04
Kittanning	do	45.6	FD	7,500	1.25
Furnace Run No. 1	do	46.5	FD	600	.02
Parker City	do	84.0	FD	900	.08
Emlenton	do	91.6	FD	1,000	.07
Saltsburg	Conemaugh River	57.5	LD	1,000	.10
Indiana	Two Lick Creek-Ramsey Run wells.	93.0	FD	10,000	.65
Hooversville	Stony Creek, impounded	131.0	LD	1,400	.03
New Bethlehem	Red Bank Creek	88.5	FD	2,000	.20
Franklin	French Creek, wells, spring	128.5	FD	14,000	2.20
Cambridge Springs	French Creek	174.0	FD	2,200	.40
New York: Olean	Olean Creek	260.0	FD	24,000	2.50
Total below sewer outfalls				920,100	107.60
70 other surface supplies				345,400	31.78
Total surface water supplies				1,265,500	139.38

[1] Miles above mouth of Allegheny River.
[2] F=Coagulated, settled, filtered; L=Lime-soda softened; D=Chlorinated.
[3] Slow sand filters.
[4] Part of population served is outside Allegheny River Basin.

The chemical quality of surface waters in this area is generally excellent except as it is modified by mine drainage, brines, or other pollutants. The alkalinity and hardness are low, particularly in the mountainous area. In the glaciated portion of the basin the water is somewhat harder and more alkaline and the taste, odor, and color

[1] Includes entire population served by Pittsburgh municipal supply and Pennsylvania Water Co., taken from Allegheny River. Part of population served is in Monongahela Basin and along the Ohio River.

troubles are often experienced due to algae growths and decomposition of organic matter in the numerous swamp areas and lakes. The alkalinity of the streams in this area, while considerably higher than Monongahela Basin upland streams, is still quite low and makes the effects of acid-mine drainage more serious than in other streams such as the Muskingum, Kentucky, and Big Sandy where alkalinities are higher.

Sewerage.—About 920,000 people in the basin are served by sewers. Only about 18 percent of the sewage is treated. Table A–3 shows data on sources of pollution and sewage treatment. More than half of the sewage is discharged untreated to the lower Allegheny in the vicinity of Pittsburgh and the Conemaugh and its tributaries in the vicinity of Johnstown, Pa.

TABLE A–3.—*Allegheny River Basin: Sources of significant pollution, including industrial wastes expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	State	Receiving stream	Miles above mouth of Allegheny	Population connected to sewers	Sewage treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Pittsburgh and suburbs.[1]	Pennsylvania.	Allegheny River	0 to 8	320,500	None	597,200	597,200
Verona	do	do	11	3,500	do	3,500	3,500
Oakmont	do	do	12	6,200	do	7,400	7,400
Springdale	do	do	17	5,000	do	5,000	5,000
Arnold	do	do	19	10,900	do	10,900	10,900
New Kensington	do	do	20	20,700	do	21,100	21,100
Tarentum	do	do	22	16,300	do	17,500	17,500
Brackenridge	do	do	22	6,900	do	6,900	6,900
Natrona	do	do	23	5,000	do	5,000	5,000
Freeport	do	do	29	2,700	do	2,700	2,700
Shenley	do	do	30			14,000	14,000
Logansport	do	do	38			2,800	2,800
Ford City	do	do	42	5,900	None	5.900	5,900
Kittanning	do	do	46	7,500	do	7,500	7,500
Franklin	do	do	125	13,000	Primary	24,000	19,500
Oil City	do	do	134	20,000	None	21,400	21,400
West Hickory	do	do	161			12,000	12,000
Warren	do	do	192	15,000	None	18,400	18,400
Salamanca	New York	do	235	9,500	do	17,000	17,000
Olean	do	do	259	24,000	Primary	28,500	19,000
Port Allegheny	Pennsylvania.	do	285	2,300	None	2,600	2,600
Coudersport	do	do	302	2,200	do	5,800	5,800

[1] Pollution loads from Pittsburgh and suburbs are distributed to Allegheny and Monongahela Basins and main Ohio River as follows:

Municipality	State	Receiving stream	Miles above mouth of Allegheny	Population connected to sewers	Sewage treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Pittsburgh and suburbs.	Pennsylvania.	Allegheny River	0–8	320,500	None	597,200	597,200
	do	Monongahela River.	0–10	319,500	do	458,500	458,500
	do	Ohio River	[a] 0–4	261,700	do	278,600	278,600
Total	do			901,700		1,334,300	1,334,300

[a] Below.

TABLE A–3.—*Allegheny River Basin: Sources of significant pollution, including industrial wastes expressed as sewered population equivalent (biochemical oxygen demand)*—Continued

Municipality	State	Receiving stream	Miles above mouth of Allegheny	Population connected to sewers	Sewage treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Leechburg	Pennsylvania.	Kiskiminetas River	35	4,300	None	4,300	4,300
Vandergrift	do	do	40	11,400	do	11,400	11,400
Apollo	do	do	44	3,200	do	3,200	3,200
Latrobe	do	Loyalhanna Creek	80	8,400	do	12,700	12,700
Blairsville	do	Conemaugh River	77	5,000	do	5,000	5,000
Johnstown and suburbs.	do	do	109	70,700	do	160,600	160,600
Derry	do	McGee Run	85	3,000	Section [2]	3,000	3,000
Westmont	do	Stony Creek	110	4,200	None	4,200	4,200
Ferndale	do	do	115	2,700	do	2,700	2,700
Windber-Paint	do	Paint Creek	122	10,700	do	10,700	10,700
East Conemaugh	do	Little Conemaugh River.	112	4,800	do	4,800	4,800
Portage	do	do	130	3,000	do	3,100	3,100
Cresson	do	do	140	2,500	do	2,500	2,500
Punxsutawney	do	Mahoning Creek	110	8,600	do	13,800	13,800
Brookville	do	Red Bank Creek	113	4,300	do	4,400	4,400
Reynoldsville	do	Sandy Lick Creek	130	3,600	do	3,600	3,600
Du Bois	do	do	146	12,000	do	13,800	13,800
Ridgway	do	Clarion River	181	6,300	do	25,300	25,300
Johnsonburg	do	do	189	4,600	do	96,600	96,600
St. Marys	do	Elk Creek	191	7,800	do	16,000	16,000
Wilcox	do	West branch Clarion River.	194			3,500	3,500
Meadville	do	French Creek	156	20,000	Secondary	29,800	12,800
Cambridge Springs	do	do	174	2,200	Primary	3,300	2,500
Rouseville	do	Oil Creek	138	1,000	None	5,800	5,800
Titusville	do	do	150	8,100	do	11,100	11,100
Mayburg	do	Tionesta Creek	175			9,600	9,600
Kane	do	East branch Tionesta Creek–Hubert Run.	210	6,300	None	6,300	6,300
Ludlow	do	Two Mile Run	200	500	do	4,700	4,700
Corry	do	Hare Creek	207	7,000	do	7,200	7,200
Jamestown	New York	Cassadago Creek	216	42,500	Primary	67,800	52,400
Falconer	do	do	217	1,200	do	28,200	27,800
Chautauqua	do	Chautauqua Lake	236	15,000	Septic tank	15,000	15,000
South Dayton	do	North branch Conewango.	237	200	None	8,600	8,600
Mount Jewett	Pennsylvania.	Kinzua Creek	235	1,400	do	7,000	7,000
Bradford	do	Tunungwant Creek	252	18,000	do	20,900	20,900
122 smaller sources				118,200	(3)	130,600	94,400
Total:							
New York				110,500		186,700	155,600
Pennsylvania				809,300		1,411,500	1,358,800
Total, entire basin				919,800		1,598,200	1,514,400

[2] Treatment plant ineffective.
[3] 18 primary and 17 secondary sewage treatment plants.

Industrial wastes.—Table A–4 summarizes data on sources of industrial wastes by type of industry and method of disposal. These wastes are equivalent in oxygen demand to sewage from about 680,000 people. A small amount of industrial waste is treated in municipal plants.

TABLE A-4.—*Allegheny River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal: Municipal sewers	Industrial waste disposal: Private outlets	At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
Brewing	7	7	0	5	53,800
Byproduct coke	2	0	2	2	84,000
Canning	3	0	3	2	57,900
Chemical	7	0	7	6	9,600
Distilling	3	0	3	3	19,600
Meat	15	10	5	11	90,600
Milk	44	14	30	13	17,900
Oil	25	0	25	23	35,900
Paper	3	0	3	2	94,400
Steel	27	6	21	11	----------
Tanning	11	0	11	6	63,700
Textile	8	2	6	4	124,300
Miscellaneous	41	12	29	5	21,500
Waste not connected municipal treatment	196	51	145	93	673,200
Waste discharged to municipal treatment					5,200
Total industrial waste in the basin					678,400
By States:					
New York					76,200
Pennsylvania					602,200

No single industry is responsible for a major part of this pollution. Textile, pulp and paper, meat, byproduct coke plants, tanneries, canneries, and breweries all are large contributors to the industrial waste load. About 40 percent of the wastes are discharged to the Allegheny in the 30-mile stretch below the mouth of the Kiskiminetas. The byproduct coke plants are at Johnstown, much of the textile industry is around Jamestown, oil refineries are scattered, but the greater number are around Oil Creek. The upper Clarion River and its tributaries receive a large part of the pulp, paper and tannery wastes.

The significance of the steel industry as a source of pollution is due almost entirely to the discharge of spent acids, acid salts, and rinse waters from pickling operations. About 27,000 pounds of free acid per day are discharged by steel mills in the basin. These mills are located along the lower Allegheny and Kiskiminetas Rivers. The acids from pickling operations represent only a small portion of the total acid load including that from mine drainage which affects these streams.

Acid mine drainage.—The Kiskiminetas River is the most heavily acid large stream in the Ohio Basin. Smaller amounts of mine drainage enter other tributaries of the Allegheny River north of the Kiskiminetas. The estimated acid load in the Allegheny River Basin, as presented in the section of the Ohio River Pollution Survey Report on Acid Mine Drainage, is shown below:

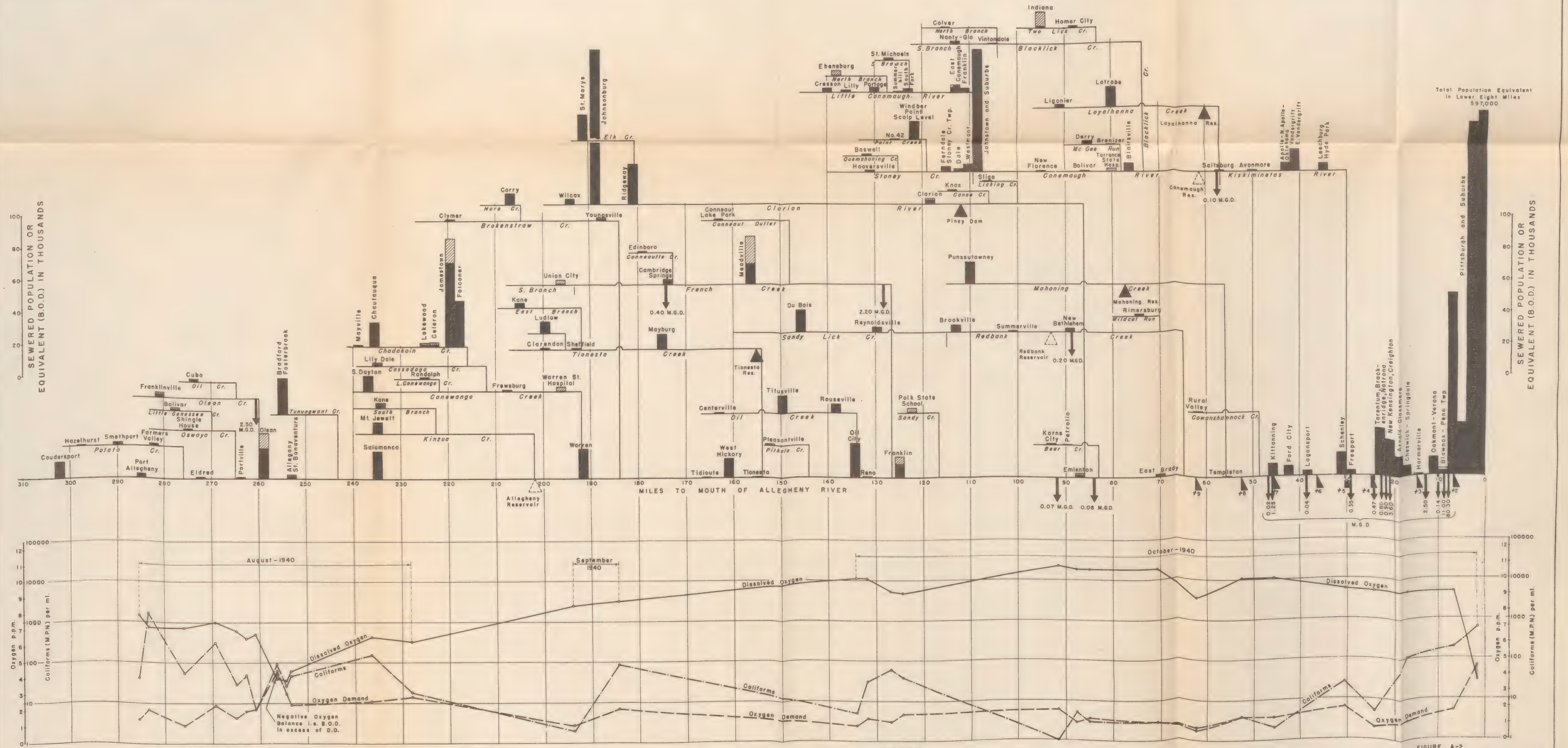


FIGURE A-2

ALLEGHENY RIVER

SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

GPO-43 O-90035

Drainage basin	Allegheny River except Kiskiminetas	Kiskiminetas River	Total Allegheny River
	Acidity in tons per year (to phenolphthalein, hot)		
Original acid load:			
Active mines	26,457	223,896	250,353
Marginal mines	6,760	23,805	30,565
Abandoned mines	50,244	73,988	124,232
Total	83,461	321,689	405,150
Per square mile	8.5	170.0	34.5
Sealed mines	24,040	20,270	44,310
Removed by sealing	18,750	10,954	29,704
Present load	64,711	310,735	375,446
Per square mile	6.6	164.2	32.0
Additional removal [1]	32,330	132,630	164,960
Future residual [2]	32,381	178,105	210,486
Per square mile	3.3	94.1	17.9

[1] Economical to remove in addition by sealing under 1940 restrictions with a cost limitation of $10 per ton of acid per year and sealing only in areas not connected to active ventilation systems.
[2] Capable of further reduction (possibly an additional 50 percent) by extended program.

Presentation of Laboratory Data

Laboratory results indicate that the most serious pollution is caused by acid mine drainage which affects tributaries throughout most of the southern part of the basin and the Allegheny River below the mouth of the Kiskiminetas. Industrial wastes discharged to the upper Clarion River and untreated sewage and industrial wastes from the Pittsburgh area near the mouth of the river also cause serious pollution. The greater part of the main stream and most of the tributaries not affected by acid were found to be in good sanitary condition.

A summary of laboratory results is shown in table A–7, acid results are in table A–7A, and selected data are in tables A–5 and A–5A. Observations in the Allegheny River Basin were made by mobile laboratory units during the period from August to December 1940. In general, observations in the southern part of the basin were more extensive than in the northern part. Figures A–3, A–4, A–5, A–5a, and A–5b show graphically the coliform, dissolved oxygen, oxygen demand, and pH results. Oxygen demand results in the portion of the basin south of Mahoning Creek are shown on an enlarged map (fig. A–5a) because of the large number of stations and the acid conditions in this area. These maps show average results at stations observed for periods of less than one month and most unfavorable monthly averages at stations observed over periods of more than one month. Stream flows at the time of sampling were generally representative of normal low-water conditions.

TABLE A–5.—*Allegheny River Basin: Selected laboratory data*

River	Allegheny	Allegheny	Allegheny	Allegheny	Allegheny	Allegheny	Allegheny
Location	Above Olean, N. Y.	Below Olean, N. Y.	Above Warren, Pa.	Below Warren, Pa.	At Oil City Pa.	Below Oil City, Pa.	Above Franklin, Pa.
River miles above mouth of Allegheny.	261	256.5	194	184 5	134.2	132	127
Period, 1940	August	August	September	September	October	October	October
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second: Sampling days	109	124	658	1, 250	1, 270	1, 350	954
Water temperature ° C	18.8	18.7	16.2	15.7	12.2	11.5	11.8
Coliforms per milliliter	7	92	2	86	5	31	61
Dissolved oxygen, parts per million	6.8	4.0	8.5	8.8	10.1	10.1	9.3
Biochemical oxygen demand, 5-day, parts per million	2.1	4.5	1.1	2.1	1.0	1.4	1.2
pH	7.1	7.2	7.3	7.4	7.4	7.4	7.3

River	Allegheny	Allegheny	Allegheny	Allegheny	Allegheny	Allegheny	Allegheny
Location	Below Franklin	Lock No. 8, Templeton	Lock No. 5, Freeport	Lock No. 4, Brackenridge	Lock No. 3, Springdale	Lock No. 2, Pittsburgh	Near mouth
River miles above mouth of Allegheny.	124.5	52.6	30.4	24.2	17	6.7	1.7
Period, 1940	October	September	September	September	September	September	September
Number of samples	3	3	3	3	4	3	2
Flow in cubic feet per second: Sampling days	1, 502	3, 100	3, 350	3, 760	4, 400	3, 510	3, 240
Water temperature ° C	11.5	19.3	19.8	19.8	22.5	21.3	20.8
Coliforms per milliliter	39	3.1	37	8	258	357	1, 420
Dissolved oxygen, parts per million	9.2	8.8	7.8	8.1	8.4	8.5	3.9
Biochemical oxygen demand, 5-day, parts per million	1.7	1.7	1.3	.7	.9	1.5	4.4
pH	7.4	7.3	7.3	6.3	6.8	6.7	6.8

River	Tunungwant Creek	Tunungwant Creek	Hubert Run	West Run	Lake Chautauqua	Chadakoin	Cassadago Creek
Location	Above Bradford	Below Bradford	Below Kane	Below Kane	Above Jamestown	At Falconer	Below Jamestown
River miles above— Confluence with Allegheny	10.5	5.5	27	51	31	26	23.5
Mouth of Allegheny	254.5	249.5	229	205	223	218	215.5
Period, 1940	August	August	September	September	September	September	September
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second: Sampling days	4	33	3	4	----------	265	297
Water temperature ° C	14.2	15.7	13.7	12.0	16.8	16.2	17.0
Coliforms per milliliter	16	2, 340	120, 300	99	24	197	191
Dissolved oxygen, parts per million	9.2	2.0	1.9	7.5	9.8	8.5	7.6
Biochemical oxygen demand, 5-day, parts per million	1.3	6.0	69.4	3.4	2.3	2.9	4.2
pH	7.2	7.1	7.0	6.8	8.2	7.4	7.5

River	Hare Creek	Oil Creek	Oil Creek	French Creek	French Creek	Sandy Lick Creek	McGee Run
Location	Below Corry	Above Titusville	Below Titusville	Above Meadville	Below Meadville	Below DuBois	Below Derry
River miles above—							
Confluence with Allegheny	22	19	15	35	26	73.5	54
Mouth of Allegheny	206	153	149	161.5	152.5	138.5	84
Period, 1940	September	October	October	October	October	September–October	October
Number of samples	3	3	3	3	3	3	1
Flow in cubic feet per second:							
Sampling days	11	8	10	122	164	19	2
Water temperature ° C	14.0	11.0	10.8	13.1	13.6	9.5	15.0
Coliforms per milliliter	38,200	4	42	5	523	31,300	24,000
Dissolved oxygen, parts per million	.2	10.7	10.3	9.5	3.7	6.6	4.2
Biochemical oxygen demand, 5-day, parts per million	16.6	1.4	1.5	3.2	4.2	37.9	33.1
pH	7.1	7.5	7.5	7.5	7.2	----------	----------

River	Clarion	Clarion	Clarion	Clarion	Clarion	Elk Creek	Crooked Creek
Location	In Johnsonburg	Above Ridgway	Below Ridgway	At Cooksburg	At St. Petersburg	Below St. Marys	Reservoir
River miles above—							
Confluence with Allegheny	101	96.5	93	51	4.5	104	8.5
Mouth of Allegheny	187	182.5	179	137	90.5	190	49
Period, 1940	September–October	September–October	September–October	October	October	September–October	November
Number of samples	6	6	6	5	3	3	1
Flow in cubic feet per second:							
Sampling days	60	82	104	219	271	4	----------
Water temperature ° C	19.4	9.5	10.1	11.6	11.3	10.3	9.0
Coliforms per milliliter	3,910	3,950	2,580	32	2	4,830	2
Dissolved oxygen, parts per million	.5	2.8	3.8	7.4	9.9	6.6	9.7
Biochemical oxygen demand, 5-day, parts per million	190	35.8	40.3	12.1	1.2	40.2	1.3
pH	7.2	7.1	6.4	7.1	7.2	6.3	6.9

River	Mahoning Creek	Stony Creek	Little Conemaugh	Conemaugh	Loyalhanna Creek	Loyalhanna Creek	Kiskiminetas
Location	Below Punxsutawney	Above Johnstown	Above Johnstown	Below Johnstown	Above Latrobe	Below Latrobe	Near Mouth
River miles above—							
Confluence with Allegheny	53	83.5	83	78	52.5	48	0.8
Mouth of Allegheny	109	113.5	113	108	82.5	78	31
Period, 1940	October	July–August	July–August	July–August	October	October	September
Number of samples	3	3	3	3	1	1	3
Flow in cubic feet per second:							
Sampling days	41	248	62	460	14	15	690
Water temperature ° C	10.5	20.8	23.5	29.3	15.0	15.0	19.5
Coliforms per milliliter	8	37	1	39	(1)	(1)	(1)
Dissolved oxygen, parts per million	11.1	7.8	7.0	4.6	9.1	1.8	7.6
Biochemical oxygen demand, 5-day, parts per million	1.1	1.0	.6	3.6	.7	3.1	1.3
Biochemical oxygen demand, 5-day, parts per million (neutralized and seeded)	1.6	.6	.5	2.0	.4	1.3	.8
pH	6.0	3.0	2.8	4.1	4.5	3.1	2.9

[1] Less than one.

TABLE A–5A.—*Allegheny River Basin: Selected laboratory chemical data*

River	Allegheny River	Allegheny River	Allegheny River	Kiskiminetas	Loyalhanna	Crabtree Creek	Conemaugh
Location	Mouth, Pittsburgh	Lock and Dam No. 3	Lock and Dam No. 4	Mouth	Mouth	Mouth	Mouth
River miles above:							
Confluence with Allegheny	----------	----------	----------	1	28	42	28
Mouth of Allegheny	1.7	17	24.2	31	58	72	58
Period, 1940	Oct. 9	Oct. 21	October	October	Oct. 14	Oct. 29	Oct. 14
Number of samples	1	1	2	5	1	1	1
Flow in cubic feet per second:							
Sampling days	2,760	2,750	2,560	419	36	13	275
Minimum month	----------	----------	----------	90	16	----------	----------
pH	4.7	5.7	5.6	2.9	2.6	3.1	2.8
Acidity, parts per million:							
Methyl red	4	3	5	200	494	1,910	176
Phenolphthalein (hot)	10	10	13	282	608	2,930	242
Iron, total parts per million	2.4	.7	7.5	9.8	79	494	26

River	Blacklick Creek	Blacklick Creek	Stony Creek	Cowanshannock Creek	Mahoning Creek	Clarion	Toby Creek
Location	Below Blacklick	South Branch Mouth	Johnstown	----------	Punxsutawney	Portland Mills	Portland Mills
River miles above:							
Confluence with Allegheny	51	76	79.5	11.5	52.8	86.9	85.9
Mouth of Allegheny	81	106	109.5	60	109	173	172
Period, 1940	Oct. 14	August	July	Oct. 24	Oct. 2	Oct. 9	Oct. 9
Number of samples	1	2	2	1	1	1	1
Flow in cubic feet per second:							
Sampling days	40	16	430	2	36	135	26
Minimum month	----------	----------	30	----------	----------	----------	----------
pH	2.4	2.6	3.0	2.9	5.2	4.7	3.0
Acidity, parts per million:							
Methyl red	612	[1] 811	78	248	----------	32	244
Phenolphthalein (hot)	788	[1] 1,047	114	398	34	56	284
Iron, total parts per million	98	222	66	75	4	4	6

[1] 1 sample.

Bacteriological data indicate the effect of acid in reducing coliform densities. Approximately one-third of the sampling stations were on acid streams and 92 percent of these stations had average coliform counts of less than 50 per milliliter. Less than 3 percent showed counts greater than 200 per milliliter. On the normal streams only 57 percent of the stations averaged less than 50 coliform organisms per milliliter and 24 percent averaged more than 200 per milliliter. Data in table A–7 on the lower Allegheny, which was affected by acid during part of the sampling period, also indicate the effect of acid on coliform counts.

Eighty-two percent of the stations on normal streams and 85 percent of those on acid streams showed average dissolved oxygen contents of more than 6.5 parts per million. About 11 percent of the normal stream stations and 5 percent of the acid stations had average dissolved oxygen contents of less than 5.0 parts per million. Zero dissolved oxygen was not found consistently at any station although it was approached below Corry, Johnsonburg, Kane, Bradford, and Latrobe. Relatively low temperatures prevailed during much of the sampling period, so the dissolved oxygen results show more favorable conditions than would have been found during the warmer months.

Fig. A-3

ALLEGHENY BASIN

COLIFORM RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. A-4

Fig. A-4

ALLEGHENY BASIN

DISSOLVED OXYGEN RESULTS

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S PUBLIC HEALTH SERVICE
1941

Fig. A-5

Fig. A-5
ALLEGHENY BASIN
BIOCHEMICAL OXYGEN DEMAND

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. A-5a

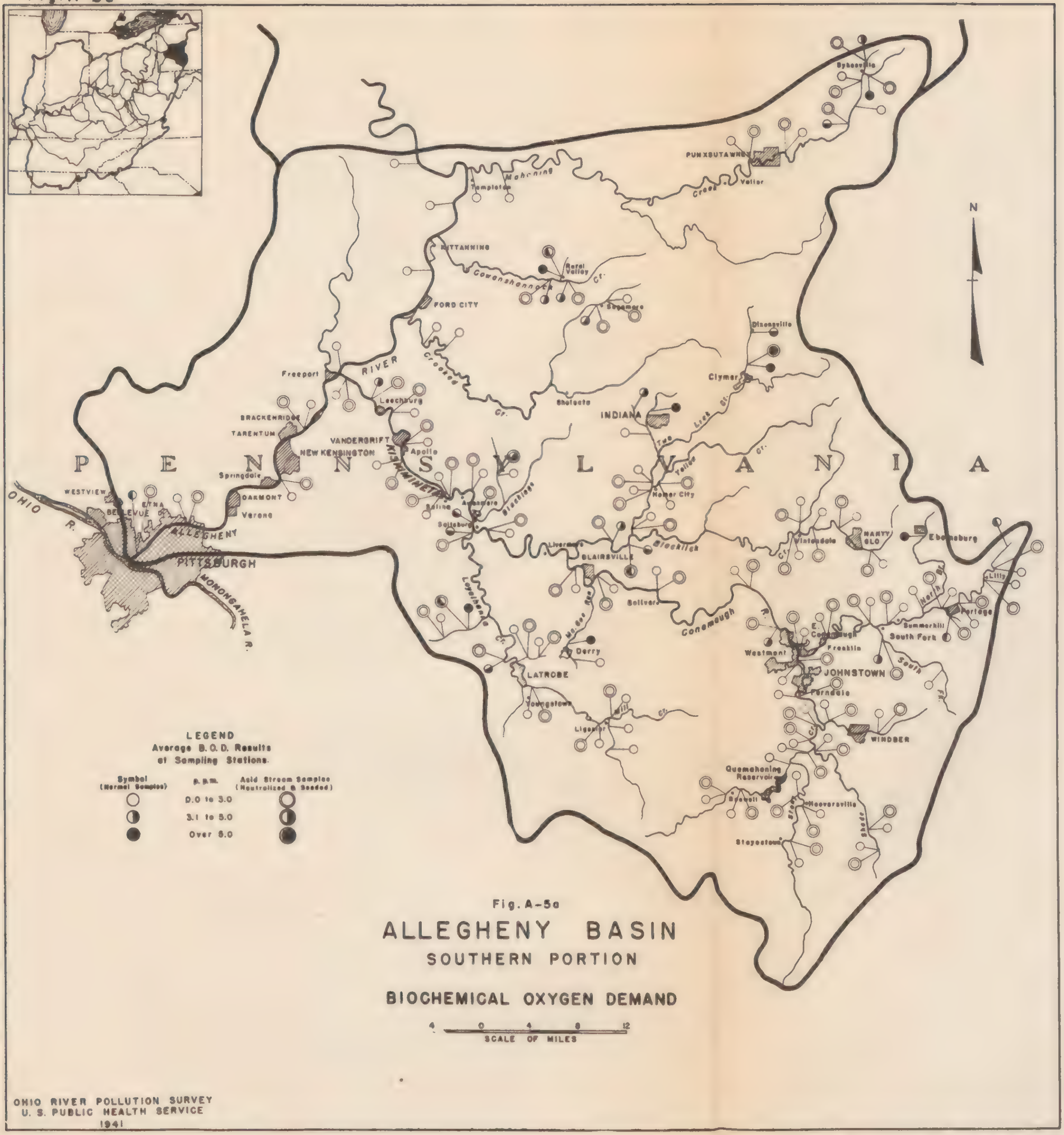


Fig. A-5a

ALLEGHENY BASIN

SOUTHERN PORTION

BIOCHEMICAL OXYGEN DEMAND

Fig. A-5b

Fig. A-5b
ALLEGHENY BASIN
pH RESULTS

Because of the effect of acid on normal biochemical oxidation, the biochemical oxygen demand tests on acid stream samples were carried out in duplicate; one portion being incubated in the acid state as collected and the other being incubated after neutralization with sodium hydroxide and seeding with filtered sewage. In general, the results of the two portions were either of the same order of magnitude or the acid portion showed a higher biochemical oxygen demand than the neutralized portion.

Approximately 75 percent of the stations on both normal and acid streams had average oxygen demands of less than 3.0 parts per million. About 15 percent of the stations on normal streams and 5 percent of those on acid streams showed average demands over 5.0 parts per million. The worst conditions were found on tributaries below Kane, St. Marys, Johnsonburg, DuBois, Derry, and Ridgway.

Considerable self-purification was indicated by laboratory results on the normal tributaries. Most of these streams were in good sanitary condition at their confluence with the Allegheny River.

Biological summary.—The plankton population of the Allegheny was found to be around 2,000 parts per million, and the stream supports a good fish population. The Kiskiminetas was too acid to support fish life or much plankton. The Clarion River, contaminated by industrial wastes, contained a good plankton and fish population but the fish are said to be unsuitable for food due to the taste of the flesh.

Hydrometric Data

Eighteen stream gaging stations are now in operation in the Allegheny River Basin. Several of the stations have records of 30 years or more. Table A–6 shows mean monthly flows at 16 stations during the dryest summers of record. Figure A–6 indicates the frequency with which minimum monthly mean summer flows have occurred at 2 stations with long records.

Station	Minimum monthly mean summer flows in cubic feet per second that may be expected once in—			
	2 years	5 years	10 years	Minimum
Allegheny River at Kittanning, Pa	2, 200	1, 450	1, 200	930
Kiskiminetas River at Avonmore, Pa	550	320	230	90

Fig. A-6

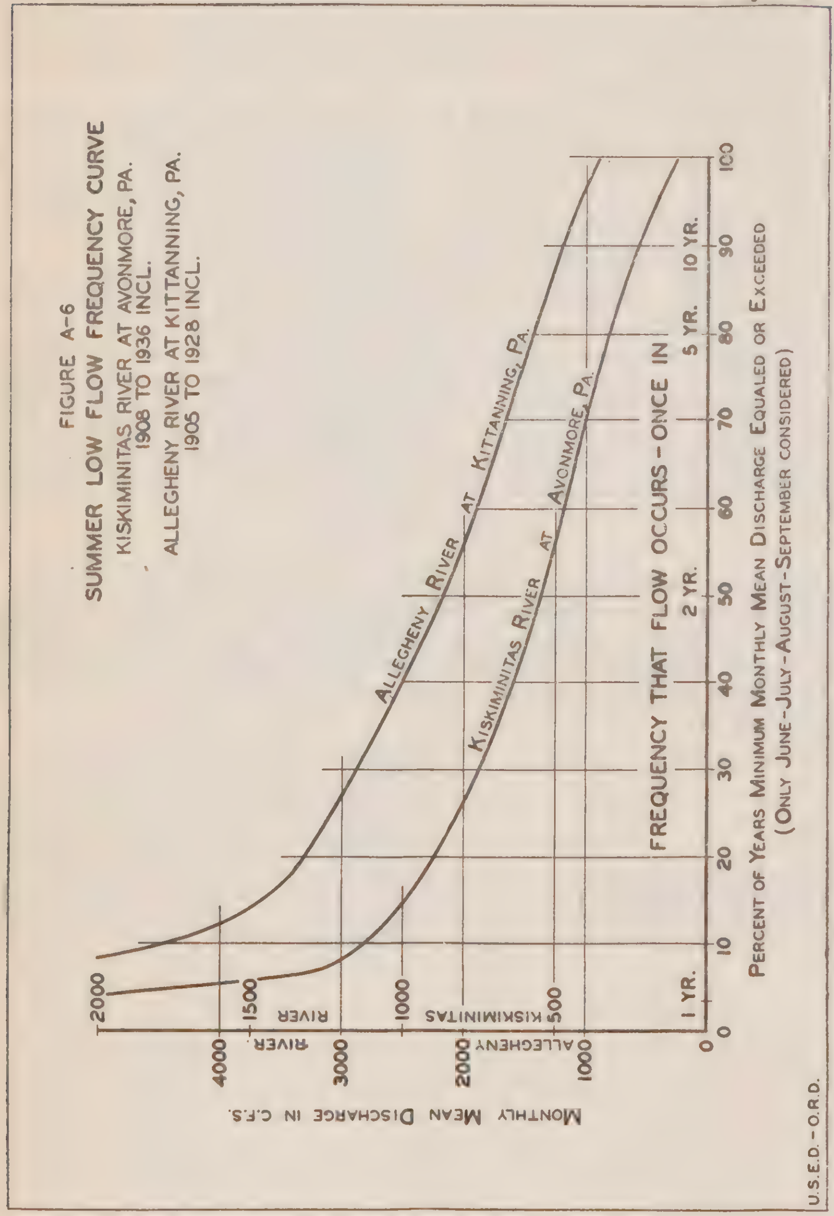


FIGURE A-6
SUMMER LOW FLOW FREQUENCY CURVE
KISKIMINITAS RIVER AT AVONMORE, PA.
1908 TO 1936 INCL.
ALLEGHENY RIVER AT KITTANNING, PA.
1905 TO 1928 INCL.
ALLEGHENY RIVER AT KITTANNING, PA.
KISKIMINITAS RIVER AT AVONMORE, PA.
FREQUENCY THAT FLOW OCCURS - ONCE IN
1 YR.
2 YR.
5 YR.
10 YR.
PERCENT OF YEARS MINIMUM MONTHLY MEAN DISCHARGE EQUALED OR EXCEEDED
(ONLY JUNE-JULY-AUGUST-SEPTEMBER CONSIDERED)
MONTHLY MEAN DISCHARGE IN C.F.S.
ALLEGHENY RIVER
KISKIMINITAS RIVER
0
10
20
30
40
50
60
70
80
90
100
500
1000
1500
2000
3000
4000
U.S.E.D. - O.R.D.

TABLE A-6.—*Allegheny River Basin: Monthly mean summer flows for years in which lowest summer flows have occurred*

River	Allegheny	Allegheny	Allegheny	Allegheny	Chadakoin
Location	Larabee, Pa.	Red House, N. Y.	Franklin, Pa.	Kittanning, Pa.	Falconer, N. Y.
River miles above:					
Confluence with Allegheny					25
Mouth of Allegheny	276	227	126	46	217
Drainage area ----square miles	541	1,690	5,982	9,010	194
Period of record	1925–39	1903–39	1918–39	1904–28	1935–39
Year	1930	1932	1930	1909	1936
June. cubic feet per second	265	809	3,030	12,014	54
July ----do	64	553	1,140	3,234	38
August ----do	21	178	414	1,421	32
September ----do	24	118	435	934	23
Year	1932	1930	1932	1908	1939
June. cubic feet per second	304	1,030	2,510	9,522	35
July ----do	122	337	2,080	9,105	42
August ----do	35	119	754	2,743	46
September ----do	23	122	531	996	29
Year	1934	1934	1934	1923	1935
June. cubic feet per second	99	299	1,106	3,640	119
July ----do	34	150	555	1,600	124
August ----do	45	144	639	1,400	199
September ----do	83	233	821	1,190	43

River	Brokenstraw Creek	Oil Creek	French Creek	Clarion	Redbank Creek
Location	Youngsville, Pa.	Rouseville, Pa.	Saegerstown, Pa.	Piney, Pa.	St. Charles, Pa.
River miles above:					
Confluence with Allegheny	4	3	36	26	15
Mouth of Allegheny	188	137	163	112	80
Drainage area ----square miles	304	300	629	980	528
Period of record	1909–39	1909–39 [1]	1921–39	1924–39	1909–39
Year	1934	1930	1934	1925	1918
June. cubic feet per second	62	130	85	601	1,234
July ----do	38	71	48	559	122
August ----do	32	31	39	178	15
September ----do	32	34	36	81	37
Year	1936	1934	1930	1930	1930
June. cubic feet per second	149	75	295	471	176
July ----do	59	38	115	245	265
August ----do	37	39	41	88	34
September ----do	32	34	70	87	46
Year	1930	1932	1936	1832	1932
June. cubic feet per second	313	117	136	432	247
July ----do	57	112	79	431	310
August ----do	50	45	60	118	94
September ----do	32	35	48	88	45

[1] From 1909 to 1931 station located 2 miles downstream, drainage area, 330 square miles.

TABLE A-6.—*Allegheny River Basin: Monthly means summer flows for years in which lowest summer flows have occurred*—Continued

River	Mahoning Creek	Crooked Creek	Stony Creek	Loyalhanna Creek	Kiskiminetas
Location	Dayton, Pa.	Ford City, Pa.	Johnstown, Pa.	New Alexandria, Pa.	Avonmore, Pa.
River miles above:					
Confluence with Allegheny	28	5	81	40	22
Mouth of Allegheny	84	46	111	70	52
Drainage area ----square miles	321	280	467	265	1,723
Period of record	1916–39	1909–39	1914–35	1919–39	1907–37
Year	1930	1930	1922	1932	1908
June..cubic feet per second	113	91	210	80	1,134
July ----do	54	20	170	43	608
August ----do	18	2.7	62	26	358
September ----do	23	4.0	30	16	90
Year	1939	1932	1925	1939	1910
June..cubic feet per second	194	45	221	122	2,825
July ----do	171	72	232	127	697
August ----do	56	8.3	90	33	192
September ----do	27	3.2	32	22	693
Year	1925	1925	1914	1930	1909
June..cubic feet per second	137	32	446	489	2,494
July ----do	157	153	230	50	431
August ----do	70	26	66	24	397
September ----do	29	6.3	34	37	217

Flow regulation.—The following reservoirs in the Allegheny River Basin are a part of the authorized program for flood control primarily for the protection of Pittsburgh. Each of the reservoirs is named for the stream on which it is located.

Reservoir	Mile [1]	Status	Net capacity	Flow available with regulation [2]
			Acre-feet	*Cubic feet per second*
Crooked Creek	47	Completed	89,500	97
Tionesta	155	do	125,600	188
Mahoning Creek	78	do	69,500	107
Loyalhanna Creek	62	do	93,500	146
Conemaugh River	65	Proposed	270,000	(3)
Allegheny River	201	do	1,105,000	1,927
Red Bank	93	do	139,000	226
French Creek	171	do	117,000	230

[1] Location of dam in river miles above mouth of Allegheny River.
[2] Maximum dependable flow at dam site during drought period July to November 1930 under one possible plan of reservoir operation. With the exception of the Allegheny River reservoir, present plans contemplate operations for flood control only.
[3] Natural flow.

Studies in progress indicate the desirability of substituting a system of small reservoirs for the large French Creek Reservoir. Among the projects receiving consideration in this connection are reservoirs on Sugar Creek (mile 138 [2]), Lake Creek (mile 140 [2]) and Sandy Creek (mile 134 [2]). The first two are tributaries of French Creek, the last is a tributary of the Allegheny about 10 miles downstream from French Creek. Studies have indicated the economic feasibility of a multiple-purpose reservoir project on the Clarion River at the Mill Creek site, 121 river miles above Pittsburgh, Pa. The flows shown in the above table are those which could be maintained below the dam sites during the period July to November 1930 the lowest flow period of record at

[2] Location of dam in river miles above mouth of Allegheny River.

Pittsburgh, by using a portion of the flood control storage for flow regulation after the end of the flood season, except in the cases of the Conemaugh River and Allegheny River Reservoirs. At the Conemaugh River site the storage capacity would be limited by physical considerations so that it is undesirable to use any of it for low-flow regulation even during the normally dry season. At the Allegheny River site ample storage capacity would be available and it is proposed to provide 195,000 acre-feet of storage expressly for low-flow regulation in addition to capacity which would be available seasonally as an incidental feature of flood-control operations.

In addition to these large projects a smaller one has been studied by the United States Engineer Department primarily for local protection at Jamestown, N. Y. The project involves improvements to the channel of the Chadakoin River (the outlet of Lake Chautauqua) and a better scheme of operation of the existing dam which regulates the outflow from Lake Chautauqua. The proposed operating scheme would limit the outflow to about 5 cubic feet per second during the summer months.

Discussion

The major pollution problems in the Allegheny River Basin are: (1) control of acid mine drainage; (2) abatement of industrial wastes, particularly in the Clarion Basin; and (3) treatment of domestic sewage, particularly in the vicinity of Pittsburgh. In addition, there are a number of other problems of a more local nature.

Control of acidity can best be accomplished by a program of mine sealing supplemented by flow regulation. This matter is more fully discussed in a separate section of this report on "Acid Mine Drainage." It is estimated that reservoir capacity of at least 210,000 acre-feet in this basin will be required for low-flow regulation. Of this, a portion could be made available at the four reservoirs already completed. The entire amount could also be provided in the proposed Allegheny River reservoir where the water quality would be good. One of the completed reservoirs, Loyalhanna Creek, is on a stream so heavily polluted with acid mine drainage that low-flow regulation by it might have a deleterious effect on the water quality of the Allegheny River. Although Mahoning Creek and Crooked Creek, on which two of the other completed reservoirs are located, also receive some acid mine drainage, they are less acid than Loyalhanna Creek and low-flow regulation by these two reservoirs would be beneficial.

Pittsburgh and vicinity.—More than 400,000 people discharge untreated sewage to the Allegheny River in the lower 30 miles below the mouth of the Kiskiminetas. Industrial wastes add a population equivalent of about 280,000. Most of this pollution enters the lower eight miles below the nine public water supply intakes on the Allegheny, but sewage from about 80,000 people enters the stream above the intakes of the two largest water supplies in the basin. Primary treatment and chlorination of all municipal sewage in this area seems justified. All or most of the wastes entering the lower eight miles of the Allegheny probably could be most economically treated, with wastes from other parts of Pittsburgh, at a large plant on the Ohio River.

The problem of the city of Pittsburgh is discussed and cost estimates are included in the report on the main Ohio River.

Kiskiminetas River.—This stream is the most highly acid large stream in the entire Ohio River Basin. While great improvement is possible, a comprehensive program of mine sealing could probably not restore it nor many of its tributaries to an alkaline condition until concentrated active mining moves, at least in part, to other areas. Sewage from about 185,000 people and industrial wastes equivalent in oxygen demand to sewage from an additional 95,000 enter the streams in this area. The largest city is Johnstown, located at the junction of the Little Conemaugh River and Stony Creek, about 70 miles above the mouth of the Kiskiminetas. Almost all of the industrial waste load and about 45 percent of the sewage enters the streams in Johnstown and vicinity. Justification of organic pollution abatement at most of the communities on highly acid streams is doubtful in the absence of effective acid control and, in general, the present need for sewage treatment at such places is not urgent. The immediate need is for a program to reduce the acidity of the streams. In conjunction with such a program, in some instances primary, and in other instances secondary treatment of sewage and organic industrial wastes will be necessary depending on the particular situation and on the degree of acid reduction attained. At Derry, located on a small stream not affected by acid, secondary treatment is indicated.

Allegheny River above Kiskiminetas.—This section of the Allegheny River is relatively clean and always alkaline. The largest cities on the stream are Olean, N. Y., and Oil City, Warren, and Franklin, Pa. Olean and Franklin have recently completed primary sewage treatment plants and the remaining large communities have taken steps toward treatment. Warren, Oil City, Ford City, and Kittanning, Pa., are building or have completed interceptors and a number of smaller municipalities have made similar progress.

Laboratory data indicate the need for more complete treatment at Olean if the stream is to be maintained in good condition at all times. At Coudersport, Pa., near the source of the Allegheny, secondary treatment is indicated. Primary treatment of sewage and organic industrial wastes should be adequate at other sources of pollution on this stretch of the Allegheny.

Clarion River.—This stream and its tributaries receive wastes with a population equivalent of 147,000, of which more than 80 percent is from a pulp and paper mill and several tanneries located in the upper part of the drainage area. In the past, downstream water plants on the Allegheny have experienced taste, odor, and color troubles, apparently due to these industrial wastes, at times when a rapid draw-down at Piney Reservoir coincided with a low-flow period on the Allegheny. An understanding with the power company which operates the Piney project, regarding rapid release of water, together with improvements in waste disposal methods at the industrial plants, have improved conditions at downstream water plants in recent years.

The Clarion River itself is still grossly polluted, however. Local oxygen depletion is common during the warm months as far downstream as Piney Dam. Although the stream was found to have a good plankton and fish population at the time of the laboratory survey, the fish are said to be inedible because of the obnoxious taste of the flesh.

All of the industries have taken steps to reduce pollution and the pulp and paper plant has spent large sums on treatment of its wastes. Continued intensive research leading to the development of better methods of disposal is not only amply justified but essential if the Clarion River is to be restored.

From the standpoint of its effect on the quality of the water in the Allegheny, the proposed flood-control and power project on the Clarion, which has been studied by the United States Engineer Department, does not seem desirable as an initial development. Although low-flow regulation by the reservoir would be valuable for neutralization of acidity in the lower Allegheny and upper Ohio Rivers, the possible deleterious effects of the polluted water at times of low flow in the Allegheny would more than outweigh the beneficial effects. Further reduction in the pollution of the Clarion River and low-flow regulation by other reservoirs which would reduce the proportion of the Allegheny flow contributed by the Clarion would make the proposed reservoir more desirable.

Other tributaries.—Most of these streams are relatively clean. Mahoning Creek, Crooked Creek, and Cowanshannock Creek are affected by acid mine drainage. Considerable progress has been made toward pollution abatement in streams not affected by acid. A program for the treatment of all wastes discharged to French Creek and its tributaries is nearing completion. Serious local nuisances still occur below Bradford, Corry, Du Bois, Kane, and a few other communities. Secondary treatment is indicated at these places. Primary treatment should be sufficient at a number of other communities where pollution is less severe.

At Jamestown and Falconer, N. Y., the Chadakoin River and Cassadago Creek are rather heavily polluted by textile wastes and municipal sewage. The cities have constructed primary treatment plants but most of the industrial wastes are discharged directly to the Chadakoin River. Either secondary waste treatment or low-flow regulation from storage in Lake Chautauqua is indicated to improve conditions.

Cost.—Estimates of the cost of existing sewage-treatment facilities and of a suggested pollution-abatement program are shown in table A–1.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Allegheny River, at city limits, Port Allegany.	A 285.5	Aug. 23, 1940	11	15.5	7.3	72.5	1.0	4	7.0		35	
Do	do	Aug. 28, 1940	82	15.0	8.0	79.2	2.3	110	7.0			
Do	do	Aug. 30, 1940	30	17.5	8.3	86.1	1.1	9	7.1			
Allegheny River, 1¼ miles below Port Allegany, Pa.	A 283.5	Aug. 23, 1940	18	16.0	5.2	52.1	2.9	2,400	7.0		35	
Do	do	Aug. 28, 1940	106	14.5	8.1	78.8	2.9	2,400	7.0	15		44
Do	do	Aug. 30, 1940	44	17.0	8.2	84.0	.4	36	7.2			32
Marvin Creek, west city limits, Smethport, Pa.	ApoM 289.8	Aug. 28, 1940	21	14.0	9.1	87.4	1.2	150	7.0	13	24	46
Do	do	Aug. 30, 1940	7	17.5	8.1	83.7	1.3	93	7.1			44
Potato Creek, 1¾ miles above Smethport, Pa.	APo 291	Aug. 23, 1940	6	15.0	8.1	79.7	.7	9	7.1		26	
Do	do	Aug. 28, 1940	22	14.0	9.2	88.3	.6	240	7.0			
Do	do	Aug. 30, 1940	28	17.5	6.7	69.2	1.4	240	7.1			
Potato Creek, 2 miles below Smethport, Pa.	APo 286	Aug. 23, 1940	14	16.5	6.0	61.4	2.0	23	7.0	10	29	54
Do	do	Aug. 28, 1940	65	14.5	8.2	79.8	2.4	1,100	7.1			
Do	do	Aug. 30, 1940	28	17.5	6.7	69.2	1.4	240	7.1			
Potato Creek, 1 mile above mouth	APo 279	Aug. 28, 1940	83	15.0	6.2	60.6	10.4	240	7.0	400	36	42
Do	do	Aug. 30, 1940	55	18.0	6.5	67.8	1.1	93	7.1	3		84
Allegheny River, 3 miles above Eldred, Pa.	A 276	Aug. 23, 1940	33	16.0	6.4	64.3	1.1	9	7.2	10	39	
Do	do	Aug. 27, 1940	34	13.5	7.4	71.1	.7	4	7.1			
Do	do	Aug. 29, 1940	179	16.0	7.8	78.2	1.4	150	7.1			
Allegheny River, 1½ miles below Eldred, Pa.	A 269.5	Aug. 23, 1940	44	16.0	8.0	80.2	1.9	240	7.1		38	66
Do	do	Aug. 27, 1940	48	13.5	7.9	75.7	1.8	240	7.0			
Do	do	Aug. 29, 1940	287	15.5	6.7	66.8	3.5	460	7.1			
Tram Hollow Run, ½ mile above Duke Center, Pa.	AKnT 276	Aug. 23, 1940	(1)	15.5	7.4	73.1	.9	24	7.4	7	120	272
Do	do	Aug. 27, 1940	1	12.0	7.7	71.2	2.2	24	7.4	3		256
Do	do	Aug. 29, 1940	(1)	15.0	8.1	79.5	1.5	240	7.4	8		284
Knapp Creek, ½ mile above Duke Center, Pa.	AKn 276	Aug. 23, 1940	1	14.5	8.2	79.6	1.3	24	7.6			
Do	do	Aug. 27, 1940	1	12.0	8.8	81.3	1.1	24	7.5			
Do	do	Aug. 29, 1940	1	15.0	8.4	83.0	1.9	24	7.4			
Knapp Creek, below Duke Center, Pa.	AKn 274.5	Aug. 23, 1940	2	15.0	5.6	55.3	1.7	460	7.3	2	114	284
Do	do	Aug. 27, 1940	2	12.5	6.9	64.5	1.1	240	7.3	5		268
Do	do	Aug. 29, 1940	3	15.0	7.6	75.3	1.2	240	7.3	5		299

Oswago Creek, 1 mile above Shinglehouse, Pa.	A Os 276	Aug. 19, 1940	15	20.5	7.2	79.6	1.9	24	7.0		33	
Do	do	Aug. 26, 1940	16	13.5	8.9	85.1	1.5	4	7.2			
Oswago Creek, 2 miles below Shinglehouse, Pa.	A Os 271.5	Aug. 19, 1940	28	20.0	7.2	78.7	2.3	110	7.0	10	44	56
Do	do	Aug. 26, 1940	24	13.0	8.8	83.1	1.0	460	7.1			
Genessee Creek, ½ mile above Bolivar, N. Y.	A OsG 278	Aug. 21, 1940	1	13.5	7.7	73.8	1.2	46	7.0		66	
Do	do	Aug. 26, 1940	1	12.0	7.0	64.5	1.0	46	7.0			
Do	do	Sept. 4, 1940	1	16.5	8.4	85.4	1.5	9	7.2			
Genessee Creek, 3 miles below Bolivar, N. Y.	A OsG 273.5	Aug. 21, 1940	4	16.0	6.0	59.9	2.0	43	7.3	3	66	192
Do	do	Aug. 26, 1940	5	13.0	6.1	57.7	1.7	240	7.2	14		190
Do	do	Sept. 4, 1940	4	18.5	6.2	66.0	2.0	23	7.3	7		188
Oswago Creek Bridge on Route 16, Mill Grove, N. Y.	A Os 266	Aug. 26, 1940	26	14.0	8.5	82.1	1.2	4	7.2	4	38	58
Allegheny River, ½ mile above Portsville, N. Y.	A 265	Aug. 16, 1940	51	20.0	7.2	78.4	1.7	2	7.1		40	
Do	do	Aug. 19, 1940	53	19.5	6.3	67.6	1.8	46	7.0			
Do	do	Aug. 27, 1940	57	12.5	7.4	69.4	1.2	46	7.1			
Allegheny River, 2 miles below Portsville, N. Y.	A 263	Aug. 16, 1940	94	20.0	6.0	65.9	2.1	15	7.1		41	
Do	do	Aug. 19, 1940	97	20.0	6.0	65.4	2.2	46	7.0			
Do	do	Aug. 27, 1940	104	13.0	7.4	70.0	1.6	93	7.2	2		96
Allegheny River, 3 miles above Olean, N. Y.	A 261	Aug. 16, 1940	99	20.0	6.4	69.8	2.1	9	7.1		43	
Do	do	Aug. 19, 1940	105	20.0	6.1	66.2	2.7	4	7.0			
Do	do	Aug. 21, 1940	122	16.5	8.0	81.6	1.5	8	7.2			
Ischua Creek, ¾ mile above Franklinville, N. Y.	A O1I 282	Aug. 21, 1940	12	10.0	9.0	79.5	1.5	24	7.5		131	
Do	do	Aug. 26, 1940	12	11.5	8.5	77.4	.5	24	7.6			
Do	do	Sept. 4, 1940	8	15.5	7.7	77.0	1.8	9	7.6			
Ischua Creek, ½ mile below Franklinville, N. Y.	A O1I 280	Aug. 21, 1940	15	13.0	7.4	70.3	4.2	4	7.4	8	107	114
Do	do	Aug. 26, 1940	19	12.5	7.6	75.7	2.8	2	7.4	8		118
Do	do	Sept. 4, 1940	19	17.0	7.0	72.1	12.4	24	7.4	3		124
Oil Creek, ½ mile above Cuba, N. Y	A O1O 275	Aug. 21, 1940	2	11.0	5.0	44.9	1.7	24	7.4		131	
Do	do	Aug. 26, 1940	1	12.0	5.9	54.5	2.3	23	7.4			
Do	do	Sept. 4, 1940	2	14.0	4.6	44.1	1.8	23	7.2			
Oil Creek, 2 miles below Cuba, N. Y	A O1O 272	Aug. 21, 1940	6	11.5	5.2	47.0	2.9	1,100	7.1	10	98	104
Do	do	Aug. 26, 1940	6	12.5	4.4	41.2	2.5	430	7.2	5		108
Do	do	Sept. 4, 1940	19	14.5	6.6	64.5	2.9	430	7.2	10		102
Olean Creek, Olean Waterworks, Olean, N. Y.	A O1 261.5	Aug. 16, 1940	34	21.0	7.1	78.8	2.3	4	7.4	14	41	
Do	do	Aug. 19, 1940	36	19.5	6.8	73.3	2.1	4	7.4	3		94
Do	do	Sept. 3, 1940	62	18.0	9.2	96.4	1.6	24	7.4	6		88
Do	do	Sept. 4, 1940	55	18.0	8.7	91.6	1.6	9	7.5	16		
Allegheny River, 1 mile below Olean, N. Y.	A 256.5	Aug. 16, 1940	113	19.0	2.2	23.9	4.3	15	7.1		77	
Do	do	Aug. 19, 1940	118	20.0	1.0	11.0	6.4	240	7.0			90
Do	do	Aug. 21, 1940	142	17.0	8.6	88.8	2.8	23	7.3			88

[1] Less than 1.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Allegheny River, ¼ mile above Allegany, N. Y.	A 254.5	Aug. 16, 1940	130		2.6		4.1	43	7.1		72	
Do	do	Aug. 20, 1940	143	16.0	4.0	40.4	2.4	23	7.1			
Do	do	Aug. 22, 1940	131	14.5	5.0	48.6	2.8	15	7.1			
Allegheny River, ½ mile below Allegany, N. Y.	A 253.5	Aug. 16, 1940	159	19.5	4.7	50.6	2.5	93	7.1		69	82
Do	do	Aug. 20, 1940	166	17.0	3.9	40.4	2.8	43	7.1			76
Do	do	Aug. 22, 1940	148	15.0	4.9	48.7	2.0	9	7.0	3		98
Tunungwant Creek, 1 mile above Bradford, Pa.	ATu 254.5	do	2	14.0	9.4	90.8	1.5	15	7.2		42	
Do	do	Aug. 27, 1940	2	13.0	9.0	85.4	1.6	24	7.2			
Do	do	Aug. 29, 1940	8	15.5	9.1	90.9	1.0	9	7.1			
East Branch, Tunungwant Creek, 1 mile above Bradford, Pa.	ATuEb 255	Aug. 22, 1940	8	14.0	8.8	84.8	2.2	9	7.2	5	53	312
Do	do	Aug. 27, 1940	8	13.0	8.7	82.3	1.6	240	7.2	8		254
Do	do	Aug. 29, 1940	24	16.0	8.5	85.8	2.4	93	7.2	7		304
Tunungwant Creek, 1½ miles below Bradford, Pa.	ATu 249.5	Aug. 22, 1940	21	15.0	.1	1.2	7.9	4,600	7.1	21	82	254
Do	do	Aug. 27, 1940	21	15.0	1.2	11.5	5.0	930	7.2	13		260
Do	do	Aug. 29, 1940	58	17.0	4.6	46.7	1.9	1,500	7.1	11		244
Tunungwant Creek, 2 miles above mouth, Irvine Mills.	ATu 246	Aug. 28, 1940	101	15.5	4.0	40.0	10.6	2,400	6.9	220	30	144
Do	do	Aug. 30, 1940	64	16.5	2.4	24.7	1.3	240	7.0	7		192
Allegheny River, 1 mile above Salamanca, N. Y.	A 235.5	Aug. 20, 1940	317	16.5	6.0	60.4	2.4	4	7.1		74	
Do	do	Aug. 29, 1940	991	17.5	7.1	73.9	3.7	460	7.2			
Do	do	Sept. 3, 1940	669	18.0	6.8	71.0	1.6	4	7.2			
Great Valley Creek, 2 miles above Ellicottville, N. Y.	AGv 249	Aug. 20, 1940	2	14.5	9.2	89.5	3.1	9	7.3		77	
Do	do	Sept. 3, 1940	8	17.0	8.7	89.5	1.2	24	7.2			
Do	do	Sept. 4, 1940	8	16.5	7.5	76.0	1.5	8	7.0			
Great Valley Creek, 2½ miles below Ellicottville, N. Y.	AGv 245.5	Aug. 20, 1940	3	15.5	9.4	93.6	1.3	24	7.3		82	
Do	do	Sept. 3, 1940	14	15.5	8.6	85.6	.7	15	7.2			
Do	do	Sept. 4, 1940	8	16.5	8.4	85.7	1.3	14	7.2	1		84
Great Valley Creek, 1 mile above Great Valley, N. Y.	AGv 243	Sept. 3, 1940	14	16.5	8.8	89.7	1.4	2,400	7.3			
Great Valley Creek, 2 miles below Great Valley, N. Y.	AGv 241	do	29	16.0	8.9	89.8	1.0	4	7.2			86

Great Valley Creek, 2½ miles above Salamanca, N. Y.	A Gv 238	Aug. 20, 1940	7	15.5	9.7	96.3	1.6	9	7.4	----------	85	96
Do	do	Aug. 22, 1940	6	12.0	8.7	80.0	1.9	9	7.4	----------	----------	80
Do	do	Sept. 3, 1940	30	17.5	9.1	94.1	1.7	43	7.3	----------	----------	----------
Little Valley Creek, 2 miles above Little Valley, N. Y.	A Lv 243.5	Aug. 20, 1940	1	17.5	9.3	96.4	1.4	46	7.2	----------	58	----------
Do	do	Aug. 22, 1940	(1)	11.5	7.5	68.5	2.2	24	7.1	----------	----------	----------
Do	do	Sept. 3, 1940	1	17.5	9.1	94.7	1.1	4	7.3	----------	----------	----------
Little Valley Creek, 2 miles below Little Valley, N. Y.	A Lv 210	Aug. 20, 1940	2	16.0	9.2	92.1	1.3	43	7.2	3	72	82
Do	do	Aug. 22, 1940	1	11.0	9.3	84.3	1.1	9	7.3	3	----------	84
Do	do	Sept. 3, 1940	1	14.7	9.5	92.8	1.3	9	7.3	9	----------	60
Allegheny River, 3 miles below Salamanca, N. Y.	A 228	Aug. 20, 1940	365	16.5	5.5	55.8	4.9	460	7.4	----------	81	----------
Do	do	Aug. 29, 1940	1,140	17.0	6.6	68.1	1.3	43	7.4	19	----------	100
Do	do	Sept. 3, 1940	684	17.0	6.8	69.9	2.4	23	7.2	2	----------	62
Cool Spring Creek, 2 miles above Steamburg, N. Y.	A CoS 226	Sept. 17, 1940	9	13.0	10.0	94.4	1.3	15	7.2	----------	33	----------
Do	do	Sept. 23, 1940	2	15.5	9.6	95.2	.9	9	7.2	----------	----------	----------
Cool Spring Creek, 1½ miles below Steamburg, N. Y.	A CoS 223.5	Sept. 17, 1940	10	13.0	8.6	81.0	2.3	460	7.2	2	27	40
Do	do	Sept. 23, 1940	2	17.0	0	0	19.6	2,400	7.2	18	----------	62
Kinzua Creek, 1 mile above Mount Jewett, Pa.	A Ki 236	Aug. 28, 1940	8	14.5	9.4	91.5	1.1	9	6.9	----------	17	----------
Do	do	Aug. 30, 1940	6	17.0	8.9	91.5	.6	24	6.9	----------	----------	----------
Kinzua Creek, 3 miles below Mount Jewett, Pa.	A Ki 231	Aug. 28, 1940	11	14.5	9.1	88.3	2.2	460	7.1	3	34	92
Do	do	Aug. 30, 1940	8	17.0	8.7	89.3	1.0	43	7.2	23	----------	120
Hubert Run, 1 mile above Kane, Pa	A KiH 231.5	Sept. 9, 1940	1	14.5	9.3	90.5	1.7	24	6.3	----------	9	----------
Do	do	Sept. 12, 1940	(1)	9.5	10.4	90.3	1.1	(1)	6.3	----------	----------	----------
Do	do	Sept. 19, 1940	(1)	12.0	10.3	95.5	1.0	(1)	7.1	----------	----------	----------
Hubert Run, ½ mile below Kane, Pa	A KiH 229	Sept. 9, 1940	3	15.0	5.1	50.3	38.3	11,000	6.9	32	56	76
Do	do	Sept. 12, 1940	2	12.0	.6	5.4	70.0	110,000	6.8	34	----------	78
Do	do	Sept. 19, 1940	2	14.0	0	0	100.0	240,000	7.2	16	----------	56
Kinzua Creek, bridge on Route 219, at mouth.	A Ki 203	Sept. 12, 1940	46	12.5	10.6	98.5	1.1	4	7.2	8	31	38
Do	do	Sept. 19, 1940	34	16.5	10.2	103.7	2.6	1	7.0	2	----------	40
Allegheny River, bridge on U. S. 6, Warren, Pa.	A 194	Sept. 10, 1940	755	17.5	8.0	82.5	1.3	4	7.2	----------	45	----------
Do	do	Sept. 16, 1940	670	15.0	8.9	87.6	1.2	1	7.4	----------	----------	----------
Do	do	Sept. 20, 1940	550	16.0	8.8	88.2	.9	1	7.2	----------	----------	----------
Little Conewango Creek, bridge, Route 17, above Randolph.	A CoLc 225	Sept. 11, 1940	40	12.5	7.6	71.3	1.8	46	7.2	----------	72	----------
Do	do	Sept. 17, 1940	40	12.5	8.2	76.5	1.1	43	7.2	----------	----------	----------
Do	do	Sept. 23, 1940	28	14.5	7.4	72.1	1.2	240	7.3	----------	----------	----------
Little Conewango Creek, 1½ miles below Randolph, N. Y.	A CoLc 223	Sept. 11, 1940	42	13.0	7.5	71.0	1.6	23	7.2	13	75	78
Do	do	Sept. 17, 1940	40	13.0	8.0	75.6	1.4	21	7.2	18	----------	50
Do	do	Sept. 23, 1940	37	15.5	7.1	70.5	.9	39	7.2	4	----------	84

[1] Less than 1.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Lake Chautauqua, Celeron Park, Celeron, N. Y.	ACoChLc 225	Sept. 11, 1940		16.0	7.2	72.8	2.5	110	7.2		49	
Do	do	Sept. 17, 1940		16.5	9.5	96.8	2.0	4	8.7			
Do	do	Sept. 23, 1940		19.5	8.7	93.5	1.9	2	8.1			
Lake Chautauqua, city limits, Jamestown, N. Y.	ACoChLc 223	Sept. 11, 1940		15.5	8.3	82.7	2.2	4	7.8	8	42	50
Do	do	Sept. 17, 1940		16.0	10.8	108.1	2.5	43	8.7	3		50
Do	do	Sept. 23, 1940		19.0	10.5	112.2	2.1	24	8.2	3		58
Chadakain River off Route 17, Falconer, N. Y.	ACoCh 218	Sept. 11, 1940	164	15.5	7.9	78.8	3.8	110	7.2		46	
Do	do	Sept. 17, 1940	332	16.0	9.1	91.9	2.7	240	7.3	18		54
Do	do	Sept. 23, 1940	300	17.0	8.4	86.2	2.5	240	7.6			
Cassadaga Creek bridge on Route 17, Levant, N. Y.	ACoCa 217	Sept. 11, 1940	31	15.5	7.1	70.5	1.4	9	7.2	15	78	84
Do	do	Sept. 17, 1940	30	14.5	7.8	76.4	1.2	2	7.2			
Do	do	Sept. 23, 1940	26	17.0	7.1	73.0	.9	4	7.2			
Cassadaga Creek, south of Route 17, Levant, N. Y.	ACoCa 215.5	Sept. 11, 1940	200	16.5	6.5	66.1	5.5	240	7.2		57	
Do	do	Sept. 17, 1940	364	16.0	8.4	84.4	3.7	240	7.8	23		56
Do	do	Sept. 23, 1940	326	18.5	7.9	83.8	3.2	93	7.4	7		62
Conewango Creek, Fifth Street Bridge, Warren, Pa.	ACo 193	Sept. 10, 1940	600	16.5	7.3	74.2	3.0	75	7.2	42	45	52
Do	do	Sept. 16, 1940	610	15.5	7.4	73.8	2.0	23	7.2	14		72
Do	do	Sept. 20, 1940	400	14.5	8.5	82.6	2.4	460	7.2	17		72
Allegheny River, 4 miles below Warren, Pa.	A 184.5	Sept. 10, 1940	1,340	17.0	7.3	75.4	2.7	150	7.2	38	42	58
Do	do	Sept. 16, 1940	1,320	16.0	7.9	79.8	1.8	93	7.3	5		76
Do	do	Sept. 20, 1940	1,090	14.0	11.1	107.2	1.8	15	7.6	7		70
Hare Creek, ¼ mile above Corry, Pa	ABrH 210	Sept. 13, 1940	10	12.0	9.6	88.3	1.4	9	7.2		53	
Do	do	Sept. 18, 1940	6	12.5	8.9	83.2	1.3	4	7.3			
Do	do	Sept. 24, 1940	7	14.5	2.5	24.2	9.9	2,400	7.1			
Hare Creek, 1 mile below Corry, Pa	ABrH 208	Sept. 13, 1940	18	12.0	3.2	29.4	4.5	1,500	7.1	23	86	
Do	do	Sept. 18, 1940	8	11.5	.6	5.6	6.9	2,400	7.1			
Do	do	Sept. 24, 1940	7	14.5	2.5	24.2	9.9	2,400	7.1			
Hare Creek, 3 miles below Corry, Pa	ABrH 206	Sept. 13, 1940	18	12.5	.6	6.0	7.4	230	7.0		99	92
Do	do	Sept. 18, 1940	8	14.0	0	0	22.6	4,300	7.2	14		100
Do	do	Sept. 24, 1940	7	15.5	0	0	19.8	110,000	7.2	15		100

Mathews Run, 2 miles above Youngsville, Pa.	ABrM 188.5	Sept. 10, 1940	6	16.0	9.5	95.1	.8	4	6.8	4	33	40
Do	do	Sept. 16, 1940	3	14.0	9.9	95.1	.7	4	7.2			34
Do	do	Sept. 20, 1940	3	14.0	9.9	95.4	.6	2	7.2			42
Brokenstraw Creek, 1 mile above Youngsville, Pa.	ABr 189	Sept. 10, 1940	112	16.5	9.3	94.3	1.8	46	7.6		67	
Do	do	Sept. 16, 1940	128	14.0	8.7	83.7	1.3	4	7.4			
Do	do	Sept. 20, 1940	82	15.0	11.6	113.9	1.7	2	8.1			
Brokenstraw Creek bridge on Route 6, Youngsville, Pa.	ABr 187.5	Sept. 10, 1940	120	16.5	9.8	99.6	1.3	43	7.6	8	68	68
Do	do	Sept. 16, 1940	132	14.5	7.3	70.7	1.2	9	7.4			
Do	do	Sept. 20, 1940	85	15.5	11.6	115.8	1.2	2	7.7			
Brokenstraw Creek bridge on U S 6, Irvine, Pa.	ABr 184	Sept. 10, 1940		17.0	9.3	95.6	1.7	24	7.5		67	
Do	do	Sept. 16, 1940	134	15.0	8.5	83.3	1.4	15	7.4	5		82
Do	do	Sept. 20, 1940	87	15.0	11.8	116.0	3.8	15	8.2	4		76
West Run, city limits, Kane, Pa.	ATiEbW 207	Sept. 9, 1940	(1)	15.0	8.9	87.6	1.3	9	7.1		35	
Do	do	Sept. 12, 1940	(1)	10.0	10.0	87.9	.8	4	7.1			
Do	do	Sept. 19, 1940	(1)	11.5	9.4	85.9	.9	2	6.9			
West Run, 2 miles below Kane, Pa.	ATiEbW 205	Sept. 9, 1940	6	15.0	7.1	70.0	3.9	240	6.5	12	20	50
Do	do	Sept. 12, 1940	4	10.0	8.3	73.1	3.2	43	7.0	2		46
Do	do	Sept. 19, 1940	3	11.0	7.1	64.2	3.2	15	6.8	1		
Two Mile Run, 1½ miles above Ludlow, Pa.	ATiT 200	Sept. 9, 1940	11	14.0	9.5	91.8	1.2	46	7.0		17	
Do	do	Sept. 12, 1940	8	9.5	10.6	92.4	1.6	9	7.1			
Do	do	Sept. 19, 1940	8	10.5	10.5	94.0	.9	4	7.1			
Two Mile Run, 1 mile below Ludlow, Pa.	ATiT 198.5	Sept. 9, 1940	17	14.5	8.9	86.8	2.0	240	7.0	16	19	34
Do	do	Sept. 12, 1940	10	10.0	9.2	81.6	3.0	1,100	7.1	7		36
Do	do	Sept. 19, 1940	8	11.0	9.1	82.1	2.3	460	7.2	4		40
Two Mile Run, at mouth, Sheffield, Pa.	ATiT 194	Sept. 10, 1940	40	15.0	8.4	82.9	2.0	460	6.6	11	28	76
Do	do	Sept. 16, 1940	16	13.5	10.0	95.4	2.7	240	7.1	3		28
Do	do	Sept. 20, 1940	12	14.0	9.1	87.7	2.1	4,600	6.3			32
Tionesta Creek, 1 mile above Sheffield, Pa.	ATi 194	Sept. 10, 1940	65	15.5	7.6	75.4	1.7	46	6.4		21	
Do	do	Sept. 16, 1940	26	14.0	9.3	89.8	1.0	8	7.0			
Do	do	Sept. 20, 1940	25	14.0	8.7	83.8	1.4	24	7.0			
Tionesta Creek 1½ miles below Sheffield, Pa.	ATi 192.5	Sept. 10, 1940	108	15.0	8.1	79.7	2.1	240	6.6	23	22	28
Do	do	Sept. 16, 1940	44	14.0	9.7	93.4	1.9	1,100	7.0	9		24
Do	do	Sept. 20, 1940	37	14.5	8.6	83.3	2.1	240	6.9	10		30
Allegheny River, State Street Bridge, Oil City, Pa.	A 134.2	Oct. 3, 1940	1,550	15.0	9.3	91.9	.3	(1)	7.4		47	
Do	do	Oct. 15, 1940	1,160	13.5	9.5	91.0	1.5	9	7.4			
Do	do	Oct. 24, 1940	1,110	8.0	11.4	96.4	1.2	4	7.3			
Oil Creek, 1 mile above Titusville, Pa.	AOi 153	Oct. 3, 1940	8	13.0	10.9	102.7	1.4	4	7.5			73
Do	do	Oct. 15, 1940	8	12.0	9.5	87.4	2.0	8	7.4			
Do	do	Oct. 24, 1940	9	8.0	11.9	100.1	.8	(1)	7.6			

[1] Less than 1.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Oil Creek, ¼ mile below Titusville, Pa.	AOi 149	Oct. 3, 1940	8	13.0	11.3	106.9	1.1	43	7.8			78
Do	do	Oct. 15, 1940	12	11.5	8.8	80.4	2.6	75	7.3			
Do	do	Oct. 24, 1940	10	8.0	10.8	91.1	.9	7	7.5			
Oil Creek, ½ mile above Rouseville, Pa.	AOi 139	Oct. 3, 1940	55	13.0	10.5	99.2	.7	(1)	7.5		45	
Do	do	Oct. 15, 1940	71	13.0	8.3	77.9	2.1	4	7.3			
Do	do	Oct. 24, 1940	78	9.0	9.9	85.2	1.4	1	7.4			
Oil Creek, ¼ mile below Rouseville, Pa.	AOi 138	Oct. 3, 1940	58	15.0	8.4	82.7	3.7	43	7.8		73	
Do	do	Oct. 15, 1940	74	14.5	7.1	68.9	5.3	460	7.2			
Do	do	Oct. 24, 1940	80	9.5	8.0	69.9	3.3	3	7.4			
Oil Creek, bridge, Seneca Ave., Oil City, Pa.	AOl 135	Oct. 3, 1940	59	18.5	5.0	53.1	3.5	240	7.4	7	71	102
Do	do	Oct. 15, 1940	76	15.0	3.1	30.5	4.2	240	7.2	23		100
Do	do	Oct. 24, 1940	82	10.0	4.4	38.8	1.7	9	7.3	8		108
Allegheny River, 2 miles below Oil City, Pa.	A 132	Oct. 3, 1940	1,610	14.0	9.8	94.1	1.2	46	7.4	8	47	60
Do	do	Oct. 15, 1940	1,240	13.0	9.4	88.3	1.7	43	7.3	5		74
Do	do	Oct. 24, 1940	1,200	7.5	11.2	93.1	1.1	4	7.4	5		64
Allegheny River, 1 mile above Franklin, Pa.	A 127	Oct. 7, 1940	1,350	17.0	8.7	89.7	1.6	46	7.4		29	
Do	do	Oct. 16, 1940	1,340	9.5	9.1	79.3	.5	43	7.2			
Do	do	Oct. 25, 1940	1,270	9.0	10.2	87.9	1.4	93	7.4			
French Creek above town of Union City, Pa.	AFrSb 197	Sept. 13, 1940	26	12.5	9.3	86.6	1.3	2	7.1		89	
Do	do	Sept. 18, 1940	18	13.5	8.8	84.0	1.1	2	7.4			
Do	do	Sept. 24, 1940	16	16.5	8.0	80.9	.9	4	7.5			
French Creek, 1¼ miles below Union City, Pa.	AFrSb 195	Sept. 13, 1940	34	13.5	9.0	85.5	4.6	930	7.3	4	92	100
Do	do	Sept. 18, 1940	21	14.0	8.6	83.3	1.6	230	7.2	2		88
Do	do	Sept. 24, 1940	16	16.5	6.3	63.9	2.2	430	7.5	8		96
French Creek, bridge on US 6, Cambridge Springs, Pa.	AFrSb 174	Sept. 13, 1940	129	14.5	8.8	85.9	.9	2	7.4		87	
Do	do	Sept. 18, 1940	79	15.5	9.2	91.3	1.4	4	7.4			
Do	do	Sept. 24, 1940	75	18.5	8.6	91.3	.9	8	7.5			
French Creek, 3 miles below Cambridge Springs, Pa.	AFrSb 172	Sept. 13, 1940	170	14.0	9.7	93.9	1.3	9	7.5	13	85	84
Do	do	Sept. 18, 1940	80	16.5	9.0	91.9	1.9	4	7.4	7		82
Do	do	Sept. 24, 1940	76	18.5	7.6	80.2	1.6	2,400	7.4	23		92

Cussewago Creek, 3 miles above Meadville, Pa.	AFrC 158.5	Oct. 15, 1940	47	12.0	7.3	67.4	1.9	1	7.2	14		68
Do	do	Oct. 24, 1940	36	10.0	6.9	60.5	2.1	1	7.2	2		80
French Creek, 3 miles above Meadville, Pa.	AFr 161.5	Oct. 3, 1940	114	15.5	10.7	106.3	.8	4	7.9		85	
Do	do	Oct. 15, 1940	124	12.5	9.4	87.8	1.2	9	7.4			
Do	do	Oct. 24, 1940	128	11.5	8.5	77.7	7.6	(1)	7.4			
French Creek, 2 miles below Meadville, Pa.	AFr 152.5	Oct. 3, 1940	157	16.0	4.4	44.6	2.7	230	7.2	14	81	86
Do	do	Oct. 15, 1940	171	14.0	1.7	16.7	6.4	240	7.2			102
Do	do	Oct. 24, 1940	165	11.0	4.9	44.0	4.3	1,100	7.3	15		96
French Creek, Thirteenth Street Bridge, Franklin, Pa.	AFr 128	Oct. 7, 1940	202	17.0	9.0	92.4	1.1	2	7.6	3	84	100
Do	do	Oct. 16, 1940	211	9.0	9.8	84.4	1.4	4	7.4			84
Do	do	Oct. 25, 1940	235	9.0	10.2	88.2	2.0	110	7.4	8		74
Allegheny River, 1 mile below Franklin, Pa.	AFr 124.5	Oct. 7, 1940	1,550	17.0	8.3	85.2	1.6	93	7.4	5	66	60
Do	do	Oct. 16, 1940	1,550	9.0	9.4	80.8	1.5	23	7.2			72
Do	do	Oct. 25, 1940	1,410	8.5	9.8	83.8	2.0	4	7.6	6		90
Lower Two Mile Run, ½ mile above mouth Franklin, Pa.	ALO 125.5	Oct. 16, 1940	3	5.5	12.2	96.5	1.2	4	7.2		130	170
Sulfur Run, bridge on route 62, Stoneboro, Pa.	ASaS 135	Oct. 7, 1940	(1)	14.0	9.1	87.8	2.6	93	7.2		264	
Do	do	Oct. 16, 1940	(1)	6.5	11.6	93.8	1.2	2	7.9			
Do	do	Oct. 25, 1940	(1)	8.5	10.5	89.8	1.7	2	7.6			
Sulfur Run, bridge near railroad station, Stoneboro, Pa.	ASaS 134.5	Oct. 7, 1940	(1)	15.0	5.4	53.2	24.0	46,000	7.8	45	210	244
Do	do	Oct. 16, 1940	1	7.0	9.8	80.4	3.7	1,500	7.5			292
Do	do	Oct. 25, 1940	1	8.5	8.3	70.9	5.2	4,300	7.9	14		324
Sandy Creek, bridge on route 62, Sandy Lake, Pa.	ASa 133.5	Oct. 7, 1940	5	15.5	10.1	100.8	1.5	4	7.6		78	
Sandy Creek, 1 mile below Sandy Lake, Pa.	ASa 132	Oct. 7, 1940	5	15.0	7.6	74.6	1.2	15	7.4		85	
Do	do	Oct. 16, 1940	5	7.0	8.7	71.7	1.1	9	7.2			104
Sandy Creek, off route 62, Polk, Pa.	ASa 123.5	Oct. 7, 1940	6	16.5	9.9	100.9	1.0	1	7.4		73	
Do	do	Oct. 16, 1940	5	6.5	11.7	95.2	1.4	1	7.4			
Do	do	Oct. 25, 1940	6	8.0	11.3	95.5	1.5	2	7.2			
Sandy Creek, ½ mile below Polk, Pa	ASa 121	Oct. 7, 1940	10	16.0	9.1	91.8	1.2	150	7.3	3	68	102
Do	do	Oct. 16, 1940	10	7.0	11.4	93.7	1.3	4	7.2			
Do	do	Oct. 25, 1940	10	8.0	11.0	92.8	1.8	9	7.4	22		94
Little Sandy Creek, bridge on route 62, Polk, Pa.	ASaL 123.5	Oct. 7, 1940	4	16.0	9.6	96.4	3.3	9	7.3		53	58
Do	do	Oct. 16, 1940	4	7.5	11.2	93.6	3.7	(1)	7.2			60
Do	do	Oct. 25, 1940	4	8.5	10.3	87.6	4.3	(1)	7.5	10		64
Allegheny River, bridge on route 38, Emlenton, Pa.	A 91.6	Oct. 10, 1940	1,740	11.0	9.9	89.0	1.2	(1)	7.3		55	
Do	do	Oct. 23, 1940	1,760	7.0	11.8	97.4	2.5	1	7.4			
Allegheny River, 3 miles below Emlenton, Pa.	A 87.8	Oct. 10, 1940	1,780	11.5	9.5	86.7	.7	8	7.4		56	
Do	do	Oct. 23, 1940	1,790	7.0	11.9	98.0	1.4	2	7.4			

[1] Less than 1.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million KKKKK	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
West Branch Clarion River, ½ mile above Wilcox, Pa.	AClWb 194.5	Sept. 9, 1940	26	15.5	9.5	94.3	1.7	240	7.0		22	
Do	do	Sept. 12, 1940	12	11.5	11.0	100.7	.9	4	7.2			
Do	do	Sept. 19, 1940	10	13.0	10.4	97.7	1.5	9	7.1			
West Branch Clarion River, 1 mile below Wilcox, Pa.	AClWb 193	Sept. 9, 1940	59	15.5	8.5	84.3	3.5	240	7.2	35	24	88
Do	do	Sept. 12, 1940	26	12.0	10.4	96.3	3.0	150	7.7	5		94
Do	do	Sept. 19, 1940	19	12.5	9.8	91.4	2.5	93	7.4	7		82
West Branch Clarion River, bridge on route 219, Johnsonburg, Pa.	AClWb 188	Sept. 30, 1940	21	11.0	10.2	92.5	5.9	110	7.2	4	31	74
Do	do	Oct. 8, 1940	22	13.5	8.8	83.8	2.8	460	6.8	3		70
Do	do	Oct. 18, 1940	22	6.0	11.4	91.3	3.2	460	6.9			98
Do	do	Oct. 28, 1940	23	8.0	11.5	97.1	1.4	430	7.2			
Do	do	Oct. 30, 1940	20	7.5	11.8	98.3	1.8	93	7.2			
Do	do	Oct. 31, 1940	21	8.0	11.6	98.1	2.3	240	7.2			
East Branch Clarion River, First Avenue Bridge, Johnsonburg, Pa.	AClEb 188	Sept. 30, 1940	40	30.5	4.1	53.8	5.2	240	7.2	5	39	50
Do	do	Oct. 8, 1940	36	13.0	8.1	76.8	1.7	93	6.9	3		46
Do	do	Oct. 18, 1940	40	8.5	12.4	105.7	3.1	4	6.8			66
Do	do	Oct. 28, 1940	29	6.0	11.8	95.0	1.8	4	7.2			
Clarion River bridge in town, Johnsonburg, Pa.	ACl 187	Sept. 30, 1940	61	21.0	0	0	159	210	7.3	65	122	
Do	do	Oct. 8, 1940	58	27.0	0	0	292	11,000	7.2			
Do	do	Oct. 18, 1940	62	20.0	0	0	268	2,400	7.1			
Do	do	Oct. 28, 1940	53	15.8	3.0	30.4	128	2,240	8.6			
Do	do	Oct. 30, 1940	62	17.0	0	0	77.5	6,700	7.0			
Do	do	Oct. 31, 1940	62	16.0	0	0	216	930	7.0			
Clarion River, 1 mile below Johnsonburg, Pa.	ACl 186	Sept. 30, 1940	65	18.0	6.1	63.5	17.5	430	6.6		74	
Do	do	Oct. 8, 1940	60	14.5	0	0	74.4	11,000	6.9			
Do	do	Oct. 18, 1940	63	9.5	0	0	117	2,400	7.0			
Do	do	Oct. 28, 1940	54	10.3	4.7	41.6	48.5	5,850	8.5			
Do	do	Oct. 30, 1940	63	11.3	0	0	35.2	9,800	7.2			
Do	do	Oct. 31, 1940	64	10.3	1.9	17.2	85.7	2,400	7.8			
Clarion River, city limits, Ridgway, Pa.	ACl 182.5	Sept. 30, 1940	87	12.0	7.6	69.7	16.5	460	6.6		52	
Do	do	Oct. 8, 1940	80	15.5	5.2	51.2	27.5	11,000	7.0			
Do	do	Oct. 18, 1940	74	8.0	.6	4.6	99.8	4,300	7.1			

Do	do	Oct. 28, 1940	74	7.5	0	0	2.8	2,400	7.2			
Do	do	Oct. 30, 1940	87	7.5	0	0	8.4	930	7.2			
Do	do	Oct. 31, 1940	88	8.5	3.7	31.7	59.2	4,600	7.3			
Elk Creek, bridge off route 120, St. Marys, Pa.	AClE 193.5	Sept. 27, 1940	2	10.0	10.8	94.9	[2] 1.5 3.4	(1)	3.1			190
Do	do	Oct. 8, 1940	2	13.5	8.0	76.5	[2] 5.5 3.1	2	3.1			400
Do	do	Oct. 18, 1940	2	8.0	9.8	82.5	[2] 4.1 5.8	(1)	3.1			450
Elk Creek, ½ mile below St. Marys, Pa.	AClE 190	Sept. 27, 1940	4	10.5	9.6	85.4	17.9	4,600	6.1	4	14	104
Do	do	Oct. 8, 1940	4	13.5	5.7	54.4	30.1	2,400	6.5			
Do	do	Oct. 18, 1940	5	7.0	4.6	37.9	72.6	7,500	6.2	190		
Elk Creek at mouth, Ridgway, Pa.	AClE 181	Sept. 30, 1940	24	10.0	10.3	90.6	1.1	46	6.3	2	4	36
Do	do	Oct. 8, 1940	18	12.5	9.4	87.3	1.7	240	7.0	7		32
Do	do	Oct. 18, 1940	74	6.5	9.9	80.5	6.0	43	7.1	6		98
Do	do	Oct. 30, 1940	24	6.5	11.5	93.5	.4	1,100	6.9	16		48
Clarion River, 1 mile below Ridgway, Pa.	ACl 179	Sept. 30, 1940	112	14.0	6.6	63.9	13.0	430	7.2	16	67	
Do	do	Oct. 8, 1940	98	14.0	6.3	60.8	8.0	1,500	7.2	18		98
Do	do	Oct. 18, 1940	90	9.0	.6	5.3	125	4,300	7.4	38		350
Do	do	Oct. 28, 1940	99	7.5	1.0	8.0	2.1	3,350	8.2			
Do	do	Oct. 30, 1940	110	7.0	3.4	28.3	9.3	2,400	7.4	48		324
Do	do	Oct. 31, 1940	111	9.0	4.9	42.2	84.4	3,500	7.4	65		276
Mill Creek, route 368, at mouth	AClM 178	Sept. 30, 1940	6	12.5	8.7	90.1	1.0	2	7.0	16	18	
Do	do	Oct. 8, 1940	7	13.0	9.6	90.4	1.5	4	7.0	7		32
Little Toby Creek, 1 mile above Brockway, Pa.	AClToL 184.5	Sept. 27, 1940	24	7.5	10.8	89.7	[2] 1.4 1.1	(1)	3.2			
Do	do	Oct. 9, 1940	18	7.5	10.2	18	[2] 3.0 1.6	(1)	3.0	8		214
Do	do	Oct. 17, 1940	20	5.5	12.0	94.7	[2] .5 1.3	(1)	3.1	15		260
Little Toby Creek, city limits, Brockway, Pa.	AClToL 182.5	Sept. 27, 1940	30	7.5	10.6	88.1	[2] 1.1 2.3	24	3.4	8		
Do	do	Oct. 8, 1940	22	8.0	9.7	81.5	[2] .9 .7	(1)	3.0			
Do	do	Oct. 17, 1940	22	6.5	9.4	76.5	[2] .9 1.2	(1)	3.1			228
Toby Creek, bridge on Route 949, at mouth.	AClTo 174	Sept. 30, 1940	26	11.0	10.6	95.2	[2] .4 1.2	(1)	3.2	3		124
Do	do	Oct. 9, 1940	26	7.0	11.4	93.9	[2] 1.1 1.2	(1)	3.0	5		156
Do	do	Oct. 17, 1940	25	7.5	12.8	106.8	[2] .1 .7	(1)	3.2	8		130
Clarion River, above Portland Mills	ACl 173	Sept. 30, 1940	142	13.0	5.1	48.4	12.2	21	6.1	35	16	158
Do	do	Oct. 9, 1940	135	9.0	7.6	65.6	[2] 4.3 2.7	43	4.7			134
Do	do	Oct. 17, 1940	126	8.0	4.5	37.6	58.8	240	6.5			
Do	do	Oct. 29, 1940	92	5.0	6.0	47.2	6.1	24	6.6			
Do	do	Oct. 31, 1940	185	6.5	8.9	72.4	17.9	46	7.1			

[1] Less than 1.
[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Clarion River, bridge in town, Arroyo, Pa.	AC1 168	Oct. 1, 1940	175	11.0	6.3	56.9	6.6	15	6.8		27	
Do	do	Oct. 9, 1940	157	10.5	4.8	42.4	24.1	240	6.6			
Do	do	Oct. 17, 1940	137	8.5	4.8	41.3	187.0	1,100	6.3			
Do	do	Oct. 29, 1940	98	6.0	6.1	48.6	8.8	93	6.8			
Do	do	Oct. 31, 1940	215	6.0	7.6	60.6	31.4	24	7.0			
Clarion River, bridge on Route 368, Millstone, Pa.	AC1 150	Oct. 1, 1940	196	11.5	6.6	60.5	6.2	24	7.1		29	
Do	do	Oct. 9, 1940	160	11.5	5.0	45.9	23.2	93	6.9			
Do	do	Oct. 17, 1940	150	9.0	6.1	52.5	48.4	9	6.8			
Do	do	Oct. 29, 1940	119	4.0	7.5	57.4	3.0	15	7.0			
Do	do	Oct. 31, 1940	245	6.0	8.5	67.9	18.4	46	6.9			
Clarion River, bridge on Route 890, Clarington, Pa.	AC1 144.5	Oct. 1, 1940	247	12.0	6.5	59.6	6.8	46	7.0		31	
Do	do	Oct. 9, 1940	181	11.5	5.5	50.1	15.8	240	7.0			
Do	do	Oct. 17, 1940	163	8.5	6.7	57.0	38.0	23	6.9			
Do	do	Oct. 29, 1940	135	4.0	7.3	55.8	4.2	9	7.1			
Do	do	Nov. 1, 1940	278	6.0	8.6	69.2	18.4	240	7.1			
Clarion River, bridge on Route 36, Cooksburg, Pa.	AC1 135	Oct. 1, 1940	286	13.0	7.2	67.9	7.5	46	7.1		28	
Do	do	Oct. 9, 1940	190	12.0	6.6	55.2	25.3	43	7.0			
Do	do	Oct. 17, 1940	176	23.0	7.2	83.1	13.7	23	7.0			82
Do	do	Oct. 29, 1940	147	4.0	7.8	59.5	7.1	2	7.2			
Do	do	Nov. 1, 1940	298	6.0	8.8	70.2	6.8	46	7.0			
Clarion River, 1 mile above Cooksburg, Pa.	AC1 137	do	300	6.5	8.8	71.4	7.0	46	7.0			
Clarion River, 5 miles south of Scotch Hill, Pa.	AC1 132	Oct. 9, 1940	198	13.5	6.5	62.0	11.8	93	7.1			
Do	do	Oct. 29, 1940	152	4.5	8.2	62.9	2.8	4	7.2			76
Do	do	Nov. 1, 1940	310	6.5	8.9	72.2	7.7	9	7.1			218
Mill Creek, Piney Reservoir, Mill Creek, Pa.	AC1Mi 123	Oct. 1, 1940		15.0	5.6	55.2	4.1	43	7.2	7	39	94
Clarion River, Piney Reservoir, Mill Creek, Pa.	AC1 122	do		13.5	7.4	71.0	3.0	24	7.0		29	
Toby Creek, bridge off Route 966, Clarion, Pa.	AC1Tob 118	do		16.5	1.5	15.4	2.0	4	6.6	4	32	98
Clarion River, bridge on Route 966, Clarion, Pa.	AC1 112	Oct. 9, 1940		16.0	2.1	20.7	3.0	4	6.6	15		78

Clarion River, bridge on Route 378, Callensburg, Pa.	AC1 101	Oct. 1, 1940	263	15.5	8.5	84.3	1.0	8	7.1		32
Do	do	Oct. 23, 1940	233	10.0	8.6	75.5	1.9	1	7.1		
Clarion River, bridge south of St. Petersburg, Pa.	AC1 90.5	Oct. 1, 1940	290	15.5	9.3	92.7	.7	2	7.2	8	28	84
Do	do	Oct. 10, 1940	248	10.5	9.7	86.9	1.7	4	7.2	2	32	90
Do	do	Oct. 23, 1940	274	8.0	10.8	90.8	1.3	(1)	7.2	12		88
Allegheny River, bridge on Route 68, Parkers Landing, Pa.	A 85	Oct. 10, 1940	2,020	11.0	10.1	91.4	1.1	4	7.3		54	
Do	do	Oct. 23, 1940	2,070	7.0	11.3	92.6	1.6	2	7.4			
Allegheny River, bridge on Route 68, East Brady, Pa.	A 70.7	Oct. 10, 1940	2,100	13.0	9.7	91.2	1.0	1	7.4		42	
Do	do	Oct. 23, 1940	2,180	8.5	11.8	100.7	1.3	4	7.4	9		78
Sandy Lick Creek above DuBois, Pa	AReS 141.5	Sept. 27, 1940	24	13.5	10.7	101.7	.6	15	6.4		80	
Do	do	Oct. 11, 1940	14	7.5	10.2	84.8	1.5	4	6.6			
Sandy Lick Creek, below Dubois, Pa	AReS 138.5	Sept. 27, 1940	25	13.5	8.2	78.3	17.2	24,000	6.5	22	89	52
Do	do	Oct. 11, 1940	15	8.5	5.6	47.9	61.6	24,000	6.7			64
Do	do	Oct. 21, 1940	16	6.5	6.0	48.9	35.0	46,000	7.1			
Falls Creek, 1 mile above Falls Creek, Pa.	AReSF 139	Sept. 27, 1940	2	11.5	10.8	98.4	1.6	4	6.5		17	
Do	do	Oct. 11, 1940	2	8.0	10.5	88.5	1.0	2	6.9			
Falls Creek, bridge on Route 830, Falls Creek, Pa.	AReSF 138	Sept. 27, 1940	10	11.5	11.0	100.6	1.3	4	6.4	20	20	24
Do	do	Oct. 11, 1940	6	8.0	10.1	84.8	2.7	110	6.9			32
Soldiers Run, ¾ mile above Reynoldsville, Pa.	AReSS 132	Oct. 2, 1940	(1)	8.5	10.5	89.5	[2] 2.0 1.2	1	3.1	4		410
Do	do	Oct. 11, 1940	(1)	5.0	10.5	82.3	[2] 1.7 1.5	(1)	3.0			520
Sandy Lick Creek, bridge on Route 322, Reynoldsville, Pa.	AReS 131.5	Oct. 2, 1940	23	10.5	7.7	68.4	1.5	9	6.5		26	
Do	do	Oct. 11, 1940	19	6.0	8.8	70.9	1.8	15	6.5			
Sandy Lick Creek, city limits, Reynoldsville, Pa.	AReS 130	Oct. 2, 1940	24	10.5	7.2	64.2	2.2	4	6.2	3	21	86
Do	do	Oct. 11, 1940	20	8.0	7.0	59.3	2.0	9	6.3			72
Sandy Lick Creek, city limits, Brookville, Pa.	AReS 115.5	Oct. 4, 1940	39	12.0	9.5	88.0	1.0	(1)	6.4	6	12	124
Do	do	Oct. 14, 1940	35	9.5	9.9	86.2	0.9	1	6.9	5		88
North Fork Red Bank Creek, bridge on route 322, Brookville, Pa.	AReNf 113.5	Oct. 4, 1940	6	11.5	10.0	.3	90.8	4	7.2	10	60	66
Do	do	Oct. 14, 1940	7	8.0	10.2	1.1	85.8	1	7.3	10		28
Red Bank Creek, city limits, Brookville, Pa.	ARe 112	Oct. 4, 1940	46	12.0	9.7	1.7	89.9	2,400	7.2		25	
Do	do	Oct. 14, 1940	42	8.5	9.6	1.6	82.1	430	7.0	3		
Do	do	Oct. 22, 1940	31	7.0	15.3	2.6	125.7	430	7.4			
Red Bank Creek, ½ mile above Summerville, Pa.	ARe 103	Oct. 4, 1940	55	10.0	10.6	.9	93.6	4	7.2		22	
Do	do	Oct. 14, 1940	50	9.0	10.0	1.0	86.5	2	7.1			
Do	do	Oct. 22, 1940	52	6.0	13.5	1.7	108.1	4	7.3			

[1] Less than 1.
[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Red Bank Creek, city limits, Summerville, Pa.	A Re 101.5	Oct. 4, 1940	55	10.5	11.0	.6	98.5	23	7.2	14	23	74
Do	do	Oct. 14, 1940	50	8.5	10.2	1.0	87.2	46	7.1			
Do	do	Oct. 22, 1940	52	4.0	14.5	2.4	110.5	240	7.3			
Red Bank Creek, 1½ mile above New Bethlehem, Pa.	A Re 87.5	Oct. 14, 1940	58	10.0	10.2	.7	90.4	1	6.9		66	
Do	do	Oct. 22, 1940	59	4.5	13.0	1.4	100.0	1	7.1			
Red Bank Creek, ½ mile below New Bethlehem, Pa.	A Re 86.5	Oct. 14, 1940	59	11.5	10.6	97.0	1.1	93	7.0		64	
Do	do	Oct. 22, 1940	62	4.5	12.8	98.9	2.3	93	6.9			70
Red Bank Creek, 3 miles south of Lawsonham, Pa.	A Re 70.5	Oct. 10, 1940	49	11.0	11.5	103.9	.5	2	7.2		21	68
Do	do	Oct. 14, 1940	64	11.5	10.9	99.1	1.4	[1]	6.9	3		82
Do	do	Oct. 23, 1940	76	8.0	12.6	106.3	.7	[1]	7.1	15		80
Allegheny River, lock No. 9	A 62.2	Oct. 10, 1940	2,150	16.0	8.9	89.3	.6	2	7.3	7	49	78
Sugar Camp Run, off route 119, Sykesville, Pa.	AMaStS 127.5	Oct. 11, 1940	1	10.0	6.3	55.4	[2] .7 3.9	[1]	6.3			368
Do	do	Oct. 21, 1940	2	10.0	6.5	57.5	[2] 1.0 5.8	[1]	6.2			388
Stump Creek, Sykesville, Pa	AMaSt 127.5	Oct. 11, 1940	6	7.0	5.8	47.8	3.9	[1]	6.4			
Do	do	Oct. 21, 1940	5	6.0	11.6	93.2	[2] 1.0 6.2	[1]	5.8			260
Stump Creek, 1 mile below Sykesville, Pa.	AMaSt 126	Oct. 2, 1940	8	9.0	3.2	27.8	0	[1]	6.1	150	21	420
Do	do	Oct. 11, 1940	8	6.5	5.8	25.0	.2	[1]	6.6			184
Do	do	Oct. 21, 1940	7	6.0	12.1	97.1	[2] 1.4 4.2	[1]	6.1	38		204
Stump Creek, bridge off route 951, Sykesville, Pa.	AMaSt 125	Oct. 2, 1940	1	8.0	10.8	91.0	1.1	.2	7.2	14	33	38
Stump Creek, 3 miles below Sykesville, Pa.	AMaSt 124	do	9	9.5	11.0	96.0	[2] 1.4 3.7	[1]	3.2	58		520
Mahoning Creek, 1 mile above Punxsutawney, Pa	AMa 113	do	33	11.0	10.4	94.1	[2] .8 1.3	1	4.5			270
Do	do	Oct. 10, 1940	44	13.5	10.2	97.6	[2] 2.4 .8	[1]	4.8			114
Do	do	Oct. 22, 1940	27	7.0	12.5	102.8	[2] 2.2 1.7	[1]	5.5			190

Mahoning Creek, bridge route 119, Punxsutawney, Pa.	AMa 109	Oct. 2, 1940	36	11.0	10.5	94.5	[2] 1.6 .9	(1)	5.2	34		230
Do	do	Oct. 10, 1940	57	13.5	10.7	102.2	1.1	1	6.4	15		
Do	do	Oct. 22, 1940	31	7.0	12.0	98.8	1.4	24	6.5			
Mahoning Creek, 7 miles above mouth.	AMa 63	Oct. 22, 1940	49	3.5	13.0	98.0	.1	(1)	6.4			178
Mahoning Creek at mouth	AMa 56.5	Oct. 10, 1940		16.0	9.4	94.2	1.1	(1)	7.3	23	45	56
Allegheny River, lock and dam No. 8	A 52.6	Aug. 20 1940	830	25.5	8.1	97.6	1.4	4	7.4		56	
Do	do	Aug. 28, 1940	1,960	21.5	8.6	96.7	1.2		7.4		55	
Do	do	Sept. 12, 1940	4,040	20.0	9.0	97.9	1.5	4	7.3		49	
Do	do	Sept. 20, 1940	2,680	18.5	8.7	91.9	1.6	7	7.3		51	
Do	do	Sept. 23, 1940	2,580	19.5	8.6	92.7	2.1	1	7.3		50	
Do	do	Oct. 3, 1940	2,610	15.0	9.8	96.5	1.4	9	7.5		50	
Do	do	Oct. 7, 1940	2,170	16.5	9.4	95.7	1.9	2	7.3		43	
Do	do	Oct. 16, 1940	1,800	14.5	9.9	96.5	1.2	4	7.5		48	
Do	do	Oct. 21, 1940	1,800	11.5	10.4	95.3	1.5	2	7.4		59	
Do	do	Oct. 31, 1940	2,200	9.0	11.2	96.5	1.5	3	7.3		60	
Do	do	Nov. 5, 1940	7,400	9.0	12.1	104.2	1.7	4	7.3		50	
Do	do	Nov. 22, 1940	11,000	4.0	13.5	103.1	.9	24	7.1		39	
Do	do	Nov. 25, 1940	12,400	6.0	13.2	105.4	1.4	15	7.2		33	
Do	do	Dec. 6, 1940	11,700	0	14.6	99.7	1.3	46	7.1		26	
Do	do	Dec. 11, 1940	27,800	1.0	14.1	99.2	3.0	100	6.9		23	
Craig Run at mouth, Rural Valley, Pa.	ACoC 62.5	Sept. 10, 1940	(1)	15.0	7.8	76.8	[2] 1.6 3.7	(1)	3.1	70		610
Do	do	Oct. 24, 1940	(1)	10.0	7.4	64.9	[2] 3.4 4.7	(1)	2.8	6		625
Do	do	Nov. 14, 1940	6	9.0	9.3	80.1	[2] 1.0 5.4	(1)	3.3	78		638
Cowanshannock Creek, upper edge Rural Valley, Pa.	ACo 63	Sept. 10, 1940	3	16.5	6.9	69.7	[2] 2.0 4.3	(1)	2.9			
Do	do	Oct. 24, 1940	1	11.0	8.8	79.0	[2] 1.0 2.6	(1)	2.8			
Do	do	Nov. 14, 1940	9	4.5	11.7	90.1	[2] 1.0 4.3	(1)	3.3			
Cowanshannock Creek ½ mile below Yatesboro, Pa.	ACo 60	Sept. 10, 1940	5	17.5	5.4	56.5	[2] 1.0 2.5	(1)	3.2	68		365
Do	do	Oct. 24, 1940	2	11.5	6.4	58.1	[2] 2.1 4.5	(1)	2.9	60		524
Do	do	Nov. 14, 1940	16	5.5	10.9	85.9	[2] .7 3.8	4	3.5	22		320
Allegheny River, lock and dam, No. 7, Kittanning, Pa.	A 45.7	Aug. 20, 1940	1,750	25.0	7.8	93.3	1.1	4	7.3		51	
Do	do	Aug. 28, 1940	2,030	21.0	8.3	92.0	.7	4	7.3		52	
Do	do	Sept. 12, 1940	4,670	20.0	8.7	95.3	1.8	4	7.3		53	
Do	do	Sept. 20, 1940	2,860	18.5	8.6	91.5	1.0	2	7.5		52	
Do	do	Sept. 23, 1940	2,490	19.5	8.4	90.8	1.0	2	7.2		45	
Do	do	Oct. 3, 1940	2,880	15.0	9.7	95.8	1.5	2	7.4		49	
Do	do	Oct. 7, 1940	2,490	16.5	9.6	97.1	1.5	1	7.4		45	
Do	do	Oct. 16, 1940	2,080	14.5	9.6	93.2	1.2	(1)	7.5		46	

[1] Less than 1.
[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Allegheny River, lock and dam, No. 7, Kittanning, Pa.	A 45.7	Oct. 21, 1940	2,080	11.0	10.4	93.5	1.3	1	7.2		48	
Do	do	Oct. 31, 1940	2,350	8.5	11.2	95.1	1.6	4	7.3		59	
Do	do	Nov. 5, 1940	7,500	9.0	11.7	100.8	1.7	6	7.2		48	
Do	do	Nov. 22, 1940	11,200	4.0	13.5	102.7	1.1	4	7.3		37	
Do	do	Nov. 25, 1940	12,600	6.0	12.8	102.3	1.4	15	7.3		39	
Do	do	Dec. 6, 1940	11,900	0	14.9	101.7	1.4	110	7.2		33	
Do	do	Dec. 11, 1940	28,300	1.0	14.2	99.8	2.2	24	6.9		25	
North Branch Plum Creek, upper edge Sagamore, Pa.	ACrP1Nb 78	Sept. 10, 1940	3	19.0	7.0	74.3	[2] .9 1.4	2	3.2			
Do	do	Oct. 24, 1940	1	9.5	9.9	86.4	[2] .5 1.4	(1)	2.9			
Do	do	Nov. 14, 1940	5	5.0	11.6	90.3	[2] 1.3 1.5	(1)	4.0			
North Branch Plum Creek, ¾ mile below Sagamore, Pa.	ACrP1Nb 77	Sept. 10, 1940	4	17.0	7.4	76.0	[2] .6 2.3	110	3.2	45		145
Do	do	Oct. 24, 1940	1	10.0	7.3	64.7	[2] .9 4.9	(1)	3.6	14		316
Do	do	Nov. 14, 1940	5	5.5	11.2	88.8	[2] .9 2.5	(1)	3.9	6		152
Crooked Creek, Crooked Creek Reservoir, above dam:												
10-foot depth	ACr 49	Nov. 7, 1940		9.0	9.7	83.3	1.3	2	6.9	6	18	126
35-foot depth	do	do		8.5	9.7	82.4	1.0	4	7.0	15	18	140
Crooked Creek Reservoir, above dam	ACr 49	Oct. 24, 1940	12				1.3		6.9		8	
Crooked Creek Reservoir, below dam	ACr 46	do	5				1.2		7.1	3	21	109
Allegheny River lock and dam No. 5, Freeport, Pa.	A 30.4	Aug. 20, 1940	1,830	25.0	7.2	86.4	.7	4	6.7		35	
Do	do	Aug. 28, 1940	2,120	21.5	7.5	84.5	.9	24	7.2		52	
Do	do	Sept. 12, 1940	4,920	20.0	8.2	89.1	1.2	43	7.3		54	
Do	do	Sept. 20, 1940	3,020	19.5	7.4	79.4	1.4	23	7.3		45	
Do	do	Sept. 23, 1940	2,120	20.0	7.8	85.0	1.2	25	7.3		52	
Do	do	Oct. 3, 1940	3,050	16.0	9.1	91.2	1.1	23	7.5		52	
Do	do	Oct. 7, 1940	3,010	16.5	9.2	93.2	1.6	9	7.4		50	
Do	do	Oct. 16, 1940	2,200	14.5	9.0	87.9	3.8	46	7.3		46	
Do	do	Oct. 21, 1940	2,200	12.0	9.4	87.2	2.0	9	7.3		45	
Do	do	Oct. 31, 1940	2,450	11.0	10.2	91.8	1.4	46	7.3		60	
Do	do	Nov. 5, 1940	7,600	9.5	10.8	94.6	1.6	110	7.3		56	
Do	do	Nov. 22, 1940	11,200	4.0	12.7	96.4	1.1	25	7.3		37	
Do	do	Nov. 25, 1940	13,000	6.0	12.4	99.6	1.1	24	7.4		37	

Do	do	Dec. 6, 1940	12,200	0	14.4	98.8	1.5	110	7.3		32	
Do	do	Dec. 11, 1940	30,700	1.0	14.7	103.4	2.5	46	6.9		24	
Conemaugh River, below all sewage, Cresson, Pa.	AKiCo 141	July 19, 1940	(1)	15.0	8.3	81.6	1.9	75	7.3		69	
Do	do	July 31, 1940	(1)	16.5	7.1	72.5	2.7	460	7.2		86	
Do	do	Aug. 8, 1940	(1)	17.0	6.4	66.1	4.6	240	7.3		97	
Conemaugh River, upper edge of Lilly, Pa.	AKiCo 136.5	July 19, 1940	1	17.5	7.5	78.0	[2] 1.3 1.5	(1)	3.5			
Do	do	July 31, 1940	1	19.0	5.6	60.4	[2] .4 1.1	15	3.4			
Do	do	Aug. 8, 1940	1	21.5	5.0	56.5	[2] 6.6 6.3	9	4.1			
Conemaugh River, ½ mile below all sewage, Lilly, Pa.	AKiCo 135.5	July 19, 1940	4	19.0	8.6	92.0	[2] 1.4 2.3	9	3.1			
Do	do	July 31, 1940	3	18.5	7.6	80.8	[2] .6 .8	1	3.1			
Do	do	Aug. 8, 1940	2	23.5	6.1	70.7	[2] 2.0 2.4	4	3.3			
Conemaugh River, upper edge of Portage, Pa.	AKiCo 131	July 19, 1940	12	20.0	8.6	94.3	[2] .3 .7	(1)	3.1			
Do	do	July 31, 1940	11	18.5	8.5	89.7	[2] .5 .5	(1)	2.9			
Do	do	Aug. 8, 1940	10	22.5	8.0	91.0	[2] .5 1.1	(1)	3.0			
Trout Run, at mouth, Portage, Pa.	AKiCoT 129	July 19, 1940	2	19.0	7.8	83.9	[2] 1.7 1.9	(1)	2.6	20		
Do	do	July 31, 1940	1	21.0	8.0	89.1	[2] 1.9 1.8	(1)	2.7	12		
Do	do	Aug. 8, 1940	1	26.5	7.1	86.7	[2] 2.7 6.0	(1)	2.7	4		
Conemaugh River, below town, Portage, Pa.	AKiCo 128.5	July 19, 1940	14	19.5	8.5	91.4	[2] 1.0 1.5	9	3.2	32		
Do	do	July 31, 1940	12	18.5	8.1	86.2	[2] .6 .8	(1)	2.9	54		
Do	do	Aug. 8, 1940	13	22.0	7.7	87.0	[2] .9 1.9	1	3.0			
North Fork Conemaugh River, 100 yds below Ebensburg, Pa.	AKiCoNf 137.5	July 19, 1940	2	17.0	7.2	74.2	6.8	93	7.0		60	
Do	do	July 31, 1940	2	20.0	7.1	77.5	1.4	240	7.3		59	
Do	do	Aug. 8, 1940	2	19.0	4.2	45.2	51.4	24,000	7.1		105	
North Fork Conemaugh River at mouth, Wilmore, Pa.	AKiCoNf 127	July 19, 1940	5	26.5	10.5	129.2	1.2	4	7.5	4	39	53
Do	do	July 31, 1940	2	24.0	8.2	96.5	.9	24	7.3	4	53	57
Do	do	Aug. 8, 1940	2	27.0	10.0	123.5	1.3	24	7.5	8	63	61
Conemaugh River, above South Fork, Pa.	AKiCo 123	July 22, 1940	33	19.5	7.8	83.8	[2] 1.7 6.6	(1)	2.7			
Do	do	July 30, 1940	26	22.5	7.3	83.3	[2] .4 .7	2	3.1			
Do	do	Aug. 7, 1940	33	20.5	7.3	80.1	[2] .5 1.0	(1)	2.9			

[1] Less than 1.
[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Conemaugh River, below South Fork Creek, below South Fork, Pa.	A KiCo 122	July 22, 1940	75	22.0	7.8	88.6	[2] .8 1.9	(1)	2.9			
Do	do	July 30, 1940	60	21.5	6.8	76.3	[2] .4 .3	1	2.8			
Do	do	Aug. 7, 1940	52	21.0	7.3	80.9	[2] .7 1.0	(1)	3.0			
South Fork Creek, above town, Beaversdale, Pa.	A KiCoSf 129	July 22, 1940	8	18.5	8.6	91.6	.7	2	6.9		14	
Do	do	July 30, 1940	6	24.0	8.4	98.1	.4	2	6.8		15	
Do	do	Aug. 7, 1940	6	18.0	8.6	90.1	.6	2	7.0		17	
South Fork Creek, above town, South Fork, Pa.	A KiCoSf 124	July 22, 1940	33	18.5	7.7	81.1	[2] 1.7 6.6	(1)	2.8	67		
Do	do	July 30, 1940	24	24.5	7.5	88.4	[2] .4 2.6	(1)	2.7	88		
Do	do	Aug 7, 1940	19	18.5	7.8	82.5	[2] 1.9 4.1	(1)	2.7	80		
Shade Creek, below town, Central City Pa.	A KiCoStS 134	July 18, 1940	6	15.5	8.8	87.9	[2] 1.6 .4	1	4.9			
Do	do	July 29, 1940	14	23.5	7.4	86.0	[2] .6 .5	24	3.8			
Do	do	Aug. 9, 1940	3	17.0	8.2	83.7	[2] .4 .2	4	4.0			
Shade Creek, below town, Reitz, Pa	A KiCoStS 132	July 18, 1940	21	16.0	8.8	88.7	[2] .2 .5	(1)	2.7			
Do	do	July 29, 1940	64	22.5	7.9	90.4	[2] .4 .7	(1)	3.0			
Do	do	Aug. 9, 1940	9	16.5	8.4	85.7	[2] .8 1.1	(1)	2.8			
Shade Creek at mouth, Seanor, Pa	A KiCoStS 123	July 18, 1940	38	20.0	8.9	97.1	[2] .1 .4	1	2.8	5		
Do	do	July 29, 1940	140	22.5	7.5	85.4	[2] .7 .9	21	3.4	42		
Do	do	Aug. 9, 1940	28	19.5	8.4	90.7	[2] .5 .6	(1)	2.8	3		
Stoney Creek Bridge on Route 30, Stoyestown, Pa.	A KiCoSt 135.5	July 17, 1940	65	17.0	9.0	92.6	.7	43	6.9		17	
Do	do	July 26, 1940	101	22.5	7.7	88.5	1.0	1,100	6.7		19	
Do	do	Aug. 12, 1940	13	19.0	8.3	89.2	[2] .4 .4	(1)	3.6			

Stoney Creek, upper edge of Hooversville, Pa.	AKiCoSt 131.5	July 17, 1940		18.0	9.0	93.8	[2] .6 .6	110	5.2			
Do	do	July 26, 1940	147	22.5	7.7	88.2	1.1	93	6.1		15	
Do	do	Aug. 12, 1940	13	19.5	8.1	87.3	[2] .2 .6	(1)	3.5			
Stoney Creek, bridge ½ mile below Hooversville, Pa.	AKiCoSt 129.5	July 17, 1940	80	18.5	8.9	94.5	[2] .6 .7	3	5.0			
Do	do	July 26, 1940	152	23.5	7.5	87.6	[2] .7 .7	21	4.2			
Do	do	Aug. 12, 1940	13	21.0	8.2	91.5	[2] .2 .3	1	3.3			
Quemahoning Creek, upper edge of Boswell, Pa.	AKiCoStQ 133	July 17, 1940	50	17.5	8.3	86.3	[2] .6 .5	24	4.1			
Do	do	July 26, 1940	20	22.0	7.2	82.0	[2] .2 .4	9	3.0			
Do	do	Aug. 12, 1940	18	20.0	7.4	80.7	[2] .3 .5	(1)	2.9			
Quemahoning Creek, ½ mile below sewers, Boswell, Pa.	AKiCoStQ 132	July 17, 1940	49	17.5	8.3	85.8	[2] .7 .9	15	4.8			
Do	do	July 26, 1940	22	22.5	7.1	81.4	[2] .4 .7	9	3.0			
Do	do	Aug. 12, 1940	17	20.5	5.7	62.8	[2] .6 .7	(1)	2.9			
Quemahoning Creek at mouth, Hollsopple, Pa.	AKiCoStQ 125	July 17, 1940	9	18.0	6.3	66.2	1.2	93	6.6	55	28	92
Do	do	July 26, 1940	1	24.5	7.0	82.8	.8	93	6.8	13	25	106
Do	do	Aug. 12, 1940	1	21.5	6.5	72.6	.7	9	6.9	17	43	93
Stoney Creek, upper edge of Hollsopple, Pa.	AKiCoSt 121	July 17, 1940	91	19.0	8.9	94.9	[2] .5 .6	2	4.4			
Do	do	July 26, 1940	154	24.5	7.5	89.1	[2] .7 .9	46	4.1			
Do	do	Aug. 12, 1940	13	21.5	8.1	90.8	[2] .3 .4	(1)	3.3			
Stoney Creek, ½ mile below Hollsopple, Pa.	AKiCoSt 123	July 17, 1940	93	19.5	8.7	91.1	[2] .4 .4	4	4.7	2		
Do	do	July 26, 1940	160	25.5	7.4	89.3	[2] .4 .6	23	4.2	27		
Do	do	Aug. 12, 1940	13	22.5	7.9	90.4	[2] .2 .6	4	3.4			
Paint Creek, above town, Windber, Pa.	AKiCoStP 125	July 18, 1940	5	19.5	8.2	88.1	[2] .4 .3	(1)	3.9			
Do	do	July 29, 1940	4	21.5	7.6	85.5	[2] .3 .4	2	3.4			
Do	do	Aug. 9, 1940	1	18.0	8.4	87.5	[2] .3 .4	(1)	3.6			
Paint Creek at mouth, Scalp Level, Pa.	AKiCoStP 119	July 18, 1940	11	19.5	8.5	91.4	[2] .8 2.3	1	2.9	30		
Do	do	July 29, 1940	17	20.5	8.0	87.8	[2] .8 1.2	1	2.8	40		
Do	do	Aug. 9, 1940	7	18.5	8.5	90.5	[2] 1.4 2.8	(1)	2.9	31		

[1] Less than 1.

[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Stoney Creek above mouth of Paint Creek, Scalp Level, Pa.	AKiCoSt 119	July 18, 1940	97	20.5	8.6	94.7	[2] .3 .6	(1)	3.3			
Do	do	July 29, 1940	254	22.5	7.4	84.9	[2] .9 1.1	240	3.4			
Do	do	Aug. 9, 1940	40	23.0	7.9	91.4	[2] .3 .6	(1)	2.9			
Stoney Creek above Ferndale and Johnstown, Pa.	AKiCoSt 113.5	July 29, 1940	604	22.0	7.2	81.2	[2] .8 1.6	110	3.4			
Do	do	Aug. 9, 1940	88	19.5	8.4	90.5	[2] .6 1.0	(1)	2.9			
Do	do	Aug. 12, 1940	52	21.0	7.8	87.2	[2] .3 .4	(1) 8	2.8 3.1	2 14		
Stoney Creek at mouth, Johnstown, Pa.	AKiCoSt 109.5	July 18, 1940	170	22.5	8.9	102.2	[2] 1.2 1.7	24	2.8	290		
Do	do	July 29, 1940	689	23.5	4.9	57.4	[2] 2.3 3.4	(1)	2.9	8		
Do	do	Aug. 9, 1940	96	21.0	5.5	61.1	[2] .7 .8					
Conemaugh River, upper edge of Johnstown, Pa.	AKiCo 113	July 22, 1940	60	25.0	7.0	83.8	[2] .5 .5	(1)	2.9			
Do	do	July 30, 1940	75	23.5	6.6	77.2	[2] .2 .4	(1)	2.8			
Do	do	Aug. 7, 1940	50	22.0	7.3	83.0	[2] .9 .7	(1)	2.8			
Conemaugh River above mouth of Stoney Creek.	AKiCo 110	July 22, 1940	237	34.5	3.6	51.1	[2] 1.1 2.6	4	4.3			
Do	do	July 30, 1940	208	33.5	3.8	53.5	[2] 2.4 2.6	4	4.0			
Do	do	Aug. 7, 1940	183	32.0	3.1	42.0	[2] 1.7 1.6	(1)	4.1			
Conemaugh River, railroad bridge below Johnstown, Pa.	AKiCo 108	July 22, 1940	415	31.0	4.5	59.7	[2] 2.1 3.7	4	4.5	108		
Do	do	do	646	29.0	5.5	70.5	[2] 1.4 2.2	110	4.0	105		
Do	do	Aug. 7, 1940	320	28.0	4.0	50.5	[2] 2.3 4.9	4	3.9	175		
Conemaugh River, bridge above Seward, Pa.	AKiCo 101	July 23, 1940	360	27.5	4.0	50.1	[2] 1.3 3.2	(1)	3.8			
Do	do	Aug. 1, 1940	275	25.5	6.8	81.3	[2] .6 .8	1	3.7			

Do	do	Aug. 5, 1940	282	26.0	6.0	72.7	[2] .1 .7	(1)	3.6	----------	----------	----------
Conemaugh River, bridge on route 256, Bolivar, Pa.	AKiCo 87	July 23, 1940	570	27.5	7.0	87.7	[2] .7 .6	9	3.7	3	----------	----------
Do	do	Aug. 1, 1940	436	26.5	7.1	87.5	[2] .9 1.1	(1)	3.5	10	----------	----------
Do	do	Aug. 5, 1940	370	26.0	7.5	90.8	[2] .5 .8	(1)	3.3	5	----------	----------
Conemaugh River, upper edge of Blairsville, Pa.	AKiCo 79	Aug. 26, 1940	383	18.5	8.1	86.0	[2] .5 .8	9	3.1	----------	----------	----------
Do	do	Oct. 14, 1940	243	15.0	8.3	81.6	[2] .6 .6	(1)	3.5	----------	----------	----------
Do	do	Nov. 19, 1940	550	4.5	11.2	86.0	[2] 2.0 2.8	(1)	4.6	----------	----------	----------
Conemaugh River, 500 yds. below bridge, Blairsville, Pa.	AKiCo 76	Aug. 26, 1940	388	18.5	7.8	82.3	[2] .5 .7	9	3.1	----------	----------	----------
Do	do	Oct. 14, 1940	245	15.5	8.4	83.6	[2] .5 1.0	1	3.5	----------	----------	----------
Do	do	Nov. 19, 1940	550	4.5	11.2	86.4	[2] 1.5 2.6	(1)	4.6	----------	----------	----------
McGee Run, upper edge of Derry, Pa.	AKiCoM 87	Sept. 9, 1940	(1)	13.0	9.6	90.1	.3	(1)	6.9	----------	28	----------
Do	do	Oct. 15, 1940	(1)	13.0	9.3	87.5	2.3	9	7.2	----------	33	----------
McGee Run, ¼ mile below Derry, Pa.	AKiCoM 84	Sept. 9, 1940	1	17.5	4.7	49.2	14.0	24,000	7.2	18	72	115
Do	do	Oct. 15, 1940	2	15.0	4.2	41.4	33.1	24,000	7.2	15	87	100
South Branch Blacklick Creek, ½ mile above Nanty Glo, Pa.	AKiCoBlSb 113	July 23, 1940	25	22.5	5.9	67.1	[2] 1.2 .8	(1)	2.7	----------	----------	----------
Do	do	Aug. 1, 1940	2	13.0	14.2	134.4	[2] .9 1.9	(1)	3.0	----------	----------	----------
Do	do	Aug. 5, 1940	2	14.0	7.6	72.9	[2] .6 0	(1)	3.0	----------	----------	----------
South Branch Blacklick Creek, 1½ miles below Nanty Glo, Pa.	AKiCoBlSb 110	July 23, 1940	26	20.5	6.0	65.7	[2] 1.4 1.6	(1)	2.6	----------	----------	----------
Do	do	Aug. 1, 1940	21	17.0	6.3	64.8	[2] .5 4.3	(1)	2.6	----------	----------	----------
Do	do	Aug. 5, 1940	22	18.5	6.4	67.7	[2] .2 1.1	(1)	2.6	----------	----------	----------
South Branch Blacklick Creek, above Vintondale, Pa.	AKiCoBlSb 106	July 23, 1940	27	22.5	7.8	89.7	[2] 1.4 .7	(1)	2.4	4	----------	----------
Do	do	Aug. 1, 1940	20	18.0	8.6	90.0	[2] .8 .3	(1)	2.6	9	----------	----------
Do	do	Aug. 5, 1940	13	19.5	8.1	87.9	[2] .2 .6	(1)	2.6	6	----------	----------
North Branch, Blacklick Creek, above town of Vintondale, Pa.	AKiCoBl 104	July 23, 1940	18	21.5	7.3	82.3	[2] 1.7 1.8	(1)	2.6	22	----------	----------
Do	do	Aug. 1, 1940	11	18.5	8.3	87.5	[2] .9 1.1	(1)	2.8	13	----------	----------
Do	do	Aug. 5, 1940	10	18.5	8.0	85.3	[2] .1 .8	(1)	2.7	17	----------	----------

[1] Less than 1.

[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Blacklick Creek, below Vintondale, Pa.	AKiCoBl 104	July 23, 1940	45	22.0	7.0	79.5	[2]1.8 1.2	(1)	2.5	18		
Do	do	Aug. 1, 1940	31	19.5	8.1	87.0	[2].9 .7	(1)	2.5	15		
Do	do	Aug. 5, 1940	31	19.0	7.4	79.1	[2].4 .3	(1)	2.6	27		
Dixon Run, ½ mile below Dixonville, Pa.	AKiCoBlTD 105.5.	Sept. 10, 1940	3	16.5	7.6	77.2	3.4	2,400	7.1	32	37	139
Do	do	Oct. 24, 1940	(1)	10.5	8.2	73.2	1.5	430	7.3		69	
Do	do	Nov. 14, 1940	4	5.5	11.0	87.3	1.8	230	7.0		34	
Dixon Run at mouth, Clymer, Pa	AKiCoBlTD 102.	Sept. 10, 1940	5	18.0	8.1	84.9	[2]5.4 5.4	46	3.7			
Do	do	Oct. 24, 1940	1	10.0	8.4	74.4	[2].4 2.8	1	3.3	10		408
Do	do	Nov. 14, 1940	5	5.5	11.2	89.0	[2].8 1.9	2	4.3	18		258
Marsh Run, at upper edge of Indiana, Pa.	AKiCoBlW 95	Sept. 11, 1940	(1)	10.5	7.9	70.2	2.4	240	7.1		60	
Do	do	Oct. 25, 1940	(1)	8.5	6.7	57.2	6.4	150	7.3		85	
Do	do	Nov. 14, 1940	(1)	6.0	9.2	74.0	1.8	7	7.0		46	
White Run, upper edge of Indiana, Pa.	AKiCoBlW 95	Sept. 11, 1940	(1)	12.0	8.7	80.3	1.1	21	7.0	10	54	73
Do	do	Oct. 25, 1940	(1)	8.5	7.8	66.5	4.8	4	7.0	7	52	63
Do	do	Nov. 14, 1940	(1)	5.0	10.0	77.7	1.2	1	6.9	5	50	77
Marsh Run below mouth of White Run.	AKiCoBl 92	Sept. 11, 1940	(1)	12.5	7.0	65.0	1.8	460	7.1	13	79	158
Do	do	Oct. 25, 1940	(1)	8.5	6.8	57.5	1.8	36	7.3	7	93	287
Do	do	Nov. 14, 1940	(1)	6.5	8.6	70.0	2.3	75	7.2	8	75	144
Two Lick Creek ¼ mile above Homer City, Pa.	AKiCoBlT 88	Sept. 11, 1940	10	15.0	9.2	90.4	[2]1.0 1.0	(1)	3.1			
Do	do	Oct. 25, 1940	7	8.5	9.9	84.7	[2]1.5 1.5	(1)	3.7			
Do	do	Nov. 14, 1940	31	5.5	11.7	92.7	[2]1.1 1.3	(1)	3.7			
Two Lick Creek ¼ mile below Homer City, Pa.	AKiCoBlT 87	Sept. 11, 1940	33	19.0	8.1	86.2	[2]1.1 1.3	2	3.0			
Do	do	Oct. 25, 1940	14	13.0	8.7	82.5	[2].9 1.0	2	3.3			
Do	do	Nov. 14, 1940	45	12.5	8.0	75.2	[2]1.1 1.2	240	3.8			

Yellow Creek water plant below dam, Homer City, Pa.	AKiCoBlY 88	Sept. 11, 1940	13	27.5	6.8	85.4	[2] .8 2.3	(1)	3.3	22		240
Do	do	Oct. 25, 1940	6	29.5	6.1	79.7	[2] .9 1.2	2	3.4	9		278
Do	do	Nov. 14, 1940	14	18.5	8.5	90.0	[2] .9 1.1	1	3.7	16		252
Two Lick Creek at mouth, Josephine, Pa.	AKiCoBlT 83	Sept. 11, 1940	38	17.0	8.6	88.0	[2] .7 1.4	(1)	3.1			330
Do	do	Oct. 25, 1940	19	10.5	9.3	83.3	[2] 1.3 1.1	(1)	2.9	4		483
Do	do	Nov. 14, 1940	47	7.5	10.8	89.4	[2] .9 2.7	(1)	3.4	4		307
Blacklick Creek, upper edge of Blacklick, Pa.	AKiCoBl 81	Aug. 26, 1940	121	16.5	8.8	89.6	[2] .8 .9	(1)	2.6			
Do	do	Oct. 14, 1940	40	12.5	9.1	84.9	[2] 4.0 4.9	(1)	2.6			
Do	do	Nov. 19, 1940	155	.5	12.4	85.7	[2] .4 1.0	(1)	3.3			
Blacklick Creek, ½ mile below Blacklick, Pa.	AKiCoBl 81	Aug. 26, 1940	124	16.5	8.9	90.4	[2] 1.1 .8	(1)	2.7	7		426
Do	do	Oct. 14, 1940	40	12.5	9.5	89.0	[2] .4 4.8	(1)	2.4	9		462
Do	do	Nov. 19, 1940	160	1.0	13.0	91.2	[2] .7 1.6	(1)	3.2	120		246
Conemaugh River water plant intake above Saltsburg, Pa.	AKiCo 58	Aug. 26, 1940	507	18.5	8.4	89.1	[2] .5 .7	(1)	2.9	5		356
Do	do	Oct. 14, 1940	275	14.5	9.0	87.2	[2] .8 .8	(1)	2.8	6		374
Do	do	Nov. 19, 1940	740	3.0	12.0	88.9	[2] .8 1.8	(1)	3.9	65		166
Mill Creek, at mouth, Ligonier, Pa.	AKiLoM 91	Sept. 9, 1940	12	18.5	7.9	83.5	[2] .6 .9	9	2.9	8		295
Do	do	Oct. 15, 1940	3	14.0	8.1	77.8	[2] 1.6 1.9	(1)	2.9	5		374
Loyalhanna Creek, above all camps, Ligonier, Pa.	AKiLo 91.5	Sept. 9, 1940	26	18.0	8.9	93.1	.8	460	7.3		27	
Loyalhanna Creek, above Ligonier, Pa.	AKiLo 91.5	Oct. 15, 1940	3	13.5	8.3	79.3	1.8	4	7.3		41	
Loyalhanna Creek, ¾ mile below Ligonier, Pa.	AKiLo 89.5	Sept. 9, 1940	41	19.0	6.9	73.8	[2] 1.2 1.2	9	4.7			
Do	do	Oct. 15, 1940	8	14.5	4.5	43.9	[2] 1.2 1.7	2	3.3	10		232
Loyalhanna Creek, 1 mile above Latrobe, Pa.	AKiLo 82.5	Sept. 9, 1940	230	18.5	8.5	89.7	.9	2	6.1		9	
Do	do	Oct. 15, 1940	14	15.0	9.0	89.2	[2] .4 .7	(1)	4.5			
Saxman Run, upper edge of Bradenville, Pa.	AKiLoS 85	Sept. 9, 1940	1	16.5	8.7	88.6	[2] .6 .7	8	4.3			
Do	do	Oct. 15, 1940	1	14.5	8.5	83.1	[2] 1.1 2.1	3	3.5			

[1] Less than 1.

[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Saxman Run, ½ mile below Bradenville, Pa.	AKiLoS 84	Sept. 9, 1940	1	16.5	8.7	88.4	[2] .3 .8	9	4.2	18	----------	246
Do	do	Oct. 15, 1940	1	14.5	8.5	82.7	[2] .8 1.5	2	3.6	8	----------	305
Loyalhanna Creek, below Saxman Run, below Latrobe.	AKiLo 78	Sept. 9, 1940	234	18.5	5.3	56.4	[2] 1.5 3.5	110	3.5	100	----------	----------
Do	do	Oct. 15, 1940	15	15.0	1.8	17.7	[2] 1.3 3.1	(1)	3.1	12	----------	----------
Crabtree Creek, upper edge of Crabtree, Pa.	AKiLoC 73	Sept. 18, 1940	(1)	12.5	9.5	88.5	[2] .3 .5	(1)	4.0	----------	----------	----------
Do	do	Oct. 29, 1940	(1)	8.0	10.1	85.0	[2] 1.2 1.4	2	4.2	----------	----------	----------
Crabtree Creek, ½ mile below Crabtree, Pa.	AKiLoC 72	Sept. 18, 1940	12	14.5	9.4	91.3	[2] .5 5.6	(1)	2.6	135	----------	1,264
Do	do	Oct. 29, 1940	13	11.5	5.4	49.3	[2] 3.4 25.1	(1)	3.1	15	----------	1,174
Loyalhanna Creek, at mouth, Saltsburg, Pa.	AKiLo 58	Aug. 26, 1940	51	17.0	8.8	89.9	[2] 1.0 .9	(1)	2.6	8	----------	649
Do	do	Oct. 14, 1940	36	12.5	9.8	91.4	[2] .7 .9	(1)	2.6	7	----------	558
Do	do	Nov. 19, 1940	120	.5	13.1	90.7	[2] .6 3.6	(1)	3.3	125	----------	275
Kiskiminetas River, 100 yards below sewer, Saltsburg.	AKi 56.5	Aug. 26, 1940	560	18.5	8.4	89.4	[2] .4 .5	(1)	2.9	4	----------	355
Do	do	Oct. 14, 1940	311	14.5	8.9	86.9	[2] 0 4.6	(1)	2.8	5	----------	401
Do	do	Nov. 19, 1940	860	1.0	13.0	91.0	[2] .8 2.1	(1)	3.3	40	----------	203
Harper Run, below Iselin, Pa.	AKiBlH 61	Aug. 26, 1940	1	14.5	9.2	89.5	[2] 1.4 1.4	24	4.3	150	----------	192
Do	do	Oct. 14, 1940	(1)	9.5	10.3	90.0	[2] 3.2 1.0	(1)	2.9	5	----------	634
Do	do	Nov. 19, 1940	1	3.0	12.0	89.4	[2] .4 .5	(1)	3.4	75	----------	422
Kiskiminetas River, highway bridge above Avonmore, Pa.	AKi 52.5	Aug. 29, 1940	1,160	21.0	8.0	89.3	[2] .4 .4	(1)	3.2	----------	----------	----------
Do	do	Sept. 30, 1940	402	13.5	9.0	86.0	[2] .5 1.4	(1)	3.0	----------	----------	----------
Do	do	Nov. 29, 1940	1,620	.5	14.3	98.9	[2] 1.1 1.1	4	3.9	----------	----------	----------

Kiskiminetas River, above Salina, Pa.	AKi 50	Aug. 29, 1940	1,180	21.0	7.7	85.2	[2] .5 1.2	(1)	3.0			
Do	do	Sept. 30, 1940	403	14.0	9.0	86.5	[2] .5 .9	(1)	2.8			
Do	do	Nov. 29, 1940	1,680	1.5	12.6	89.9	[2] .7 2.6	4	3.5			
Kiskiminetas River, ½ mile below Salina, Pa.	AKi 49	Aug. 29, 1940	1,170	21.5	7.7	86.5	[2] .4 1.2	(1)	3.0			
Do	do	Sept. 30, 1940	403	14.5	9.0	87.9	[2] .4 1.2	(1)	2.9			
Do	do	Nov. 29, 1940	1,700	1.5	13.1	93.4	[2] 1.1 2.6	4	3.7			
Kiskiminetas River, above Apollo, Pa.	AKi 45	Aug. 29, 1940	1,180	21.5	7.9	88.2	[2] .8 1.4	(1)	2.9			
Do	do	Sept. 30, 1940	423	14.5	9.0	87.8	[2] .7 1.1	(1)	2.9			
Do	do	Nov. 29, 1940	1,910	1.5	13.7	97.3	[2] .6 2.6	4	3.7			
Kiskiminetas River, above Vandergrift, Pa.	AKi 40.5	Aug. 29, 1940	1,280	22.0	7.2	81.1	[2] .8 1.8	(1)	2.9			
Do	do	Sept. 30, 1940	425	14.5	9.1	88.9	[2] .6 .7	(1)	2.8			
Do	do	Nov. 29, 1940	2,090	1.5	14.0	99.5	[2] 1.4 2.5	21	3.7			
Kiskiminetas River, near Brady Run, Leechburg, Pa.	AKi 36.5	Aug. 29, 1940	1,310	22.0	7.0	78.7	[2] .4 2.0	(1)	3.0	13		349
Do	do	Sept. 30, 1940	438	15.5	8.6	85.3	[2] .6 2.1	(1)	2.9	10		360
Do	do	Nov. 29, 1940	2,210	1.0	13.7	96.4	[2] .4 1.3	4	4.1	38		170
Kiskiminetas River, near Hyde Park, West Leechburg, Pa.	AKi 34.5	Aug. 29, 1940	1,300	22.5	7.9	90.5	[2] .5 2.1	(1)	3.1			
Do	do	Sept. 30, 1940	435	15.0	8.7	86.0	[2] .6 .8	1	3.0			
Do	do	Nov. 29, 1940	2,170	1.5	13.7	97.9	[2] .6 4.1	8	3.9			
Kiskiminetas River, at mouth, Freeport, Pa.	AKi 31	Aug. 20, 1940	465	25.0	7.5	89.0	1.6	3	7.4	10	45	98
Do	do	Aug. 28, 1940	1,470	19.5	7.3	76.5	[2] .8 1.2	(1)	2.9	10		324
Do	do	Sept. 12, 1940	1,180	17.0	8.0	82.2	[2] 1.1 1.3	(1)	2.9	5		270
Do	do	Sept. 20, 1940	450	20.0	7.4	80.2	[2] .5 1.7	(1)	2.9	7		301
Do	do	Sept. 23, 1940	440	21.5	7.3	81.7	[2] .7 .9	(1)	2.8	6		329
Do	do	Oct. 3, 1940	403	16.0	8.4	84.2	[2] .9 2.8	(1)	3.0	5		356
Do	do	Oct. 7, 1940	367	18.5	8.4	89.3	[2] .9 1.0	(1)	2.9	7		315

[1] Less than 1.
[2] Seeded and neutralized.

TABLE A-7.—*Allegheny River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen, Parts per million	Dissolved oxygen, Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Kiskiminetas River, at mouth, Freeport, Pa.	AKi 31	Oct. 16, 1940	335	14.0	8.4	80.8	[2] 1.1 4.1	(1)	2.8	6		386
Do	do	Oct. 21, 1940	362	7.5	11.0	91.2	[2] 1.8 1.8	(1)	2.8	5		428
Do	do	Oct. 31, 1940	630	10.5	9.7	86.2	[2] 1.4 3.1	(1)	3.0	5		403
Do	do	Nov. 5, 1940	1,400	10.5	9.9	88.3	[2] .9 3.6	1	3.5	8		225
Do	do	Nov. 22, 1940	1,120	7.5	10.9	91.0	[2] 1.2 3.0	(1)	3.3	9		297
Do	do	Nov. 25, 1940	1,150	6.0	9.8	78.8	[2] .9 1.9	1	3.3	5		282
Do	do	Dec. 6, 1940	2,000	0	13.6	93.0	[2] .7 2.1	1	3.6	5		175
Do	do	Dec. 11, 1940	3,480	4.0	12.4	94.7	[2] .5 2.3	1	3.6	6		198
Allegheny River, lock and dam No. 4, Breckenridge, Pa.	A 24.2	Aug. 20, 1940	2,340	25.5	7.1	85.1	[2] .3 .4	(1)	4.3			
Do	do	Aug. 28, 1940	4,170	21.0	8.3	92.3	[2] .2 .3	(1)	4.3			
Do	do	Sept. 12, 1940	5,760	19.5	8.5	91.6	.8	(1)	6.1		10	
Do	do	Sept. 20, 1940	2,970	19.5	8.2	88.8	.6	3	6.4		13	
Do	do	Sept. 23, 1940	2,550	20.5	7.8	85.4	1.1	24	6.4		14	
Do	do	Oct. 3, 1940	3,470	16.5	9.2	92.9	.6	23	6.9		29	
Do	do	Oct. 7, 1940	3,050	17.0	9.2	94.4	.7	2	6.6		20	
Do	do	Oct. 16, 1940	2,560	14.7	8.8	86.4	[2] 1.4 1.2	(1)	5.5			
Do	do	Oct. 21, 1940	2,560	11.5	9.1	83.2	[2] .7 .7	(1)	5.7			
Do	do	Oct. 31, 1940	3,100	11.0	10.0	90.3	.8	(1)	6.5		19	
Do	do	Nov. 5, 1940	9,000	11.0	10.5	95.0	1.2	15	7.0		45	
Do	do	Nov. 22, 1940	12,300	5.0	12.3	96.0	.9	9	6.9		31	
Do	do	Nov. 25, 1940	14,500	6.0	12.1	96.6	1.2	43	7.2		29	
Do	do	Dec. 6, 1940	14,500	.5	14.2	98.3	1.6	46	7.0		28	
Do	do	Dec. 11, 1940	34,500	1.0	14.4	101.5	2.4	46	6.9		22	
Allegheny River, lock and dam No. 3, Springdale, Pa.	A 17	Aug. 20, 1940	2,360	28.0	6.8	76.8	[2] .5 .8	(1)	4.4			
Do	do	Aug. 28, 1940	4,210	24.5	7.9	94.0	[2] .5 .6	(1)	4.3			
Do	do	Sept. 5, 1940	6,000	24.0	8.6	100.2	.8	240	6.7		24	

Do	do	Sept. 12, 1940	5,310	21.0	8.8	98.3	1.1	102	6.7	10	25	111
Do	do	Sept. 20, 1940	3,200	22.0	8.4	95.1	.8	24	6.7	10	21	116
Do	do	Sept. 23, 1940	3,110	23.0	8.0	92.5	1.3	93	6.7	12	16	120
Do	do	Oct. 3, 1940	4,000	19.0	9.0	96.6	1.2	460	6.9	8	34	110
Do	do	Oct. 17, 1940	3,110	19.0	8.8	94.4	1.0	43	6.8	10	26	119
Do	do	Oct. 16, 1940	2,750	18.0	9.0	94.1	1.1	9	6.8	7	15	111
Do	do	Oct. 21, 1940	2,750	14.5	9.0	88.0	[2] 1.2; 1.2	1	5.7	4		123
Do	do	Oct. 31, 1940	3,110	14.0	10.0	96.6	1.5	2	6.5	6	14	131
Do	do	Nov. 5, 1940	9,200	10.5	11.2	99.9	1.7	43	6.7	5	26	120
Do	do	Nov. 22, 1940	12,500	6.5	12.4	100.4	1.2	46	6.8	10	26	91
Do	do	Nov. 25, 1940	15,500	6.0	12.8	102.6	1.8	110	7.2	12	31	82
Do	do	Dec. 6, 1940	15,100	1.0	14.2	99.8	1.2	24	7.0	8	22	63
Do	do	Dec. 11, 1940	37,500	1.5	14.6	103.8	1.5	46	6.9	12	21	64
Allegheny River lock and dam No. 2, Pittsburgh, Pa.	A 6.7	Aug. 20, 1940	2,380	27.0	6.8	84.5	1.5	2,400	6.6	6	9	130
Do	do	Aug. 28, 1940	4,240	24.0	8.1	94.6	[2] .5; .5	36	4.4	3		
Do	do	Sept. 5, 1940	6,050	23.0	8.6	98.7	1.3	460	6.5	7	12	130
Do	do	Sept. 16, 1940	2,700	20.0	8.6	93.3	1.0	460	6.7		14	
Do	do	Sept. 25, 1940	3,790	21.0	8.2	91.1	2.1	448	6.8		17	
Do	do	Oct. 4, 1940	3,240	16.0	9.1	91.7	1.2	43	6.8		33	
Do	do	Oct. 9, 1940	2,760	18.0	8.9	93.6	1.5	240	6.9		26	
Do	do	Oct. 18, 1940	2,800	15.5	9.3	92.3	2.9	460	6.9		19	
Do	do	Oct. 23, 1940	2,800	13.0	9.4	88.8	1.5	240	6.7		13	
Do	do	Nov. 1, 1940	9,300	13.5	9.7	92.8	2.5	460	6.8		14	
Do	do	Nov. 6, 1940	8,660	10.5	12.0	107.0	1.8	37	7.0		24	
Do	do	Nov. 13, 1940	9,300	7.5	12.5	104.2	1.9	240	7.0		33	
Do	do	Nov. 27, 1940	15,200	6.5	12.4	100.6	1.3	150	6.8		28	
Do	do	Dec. 4, 1940	22,700	.5	15.9	110.0	2.5	838	6.8		22	
Do	do	Dec. 10, 1940	39,800	1.0	15.0	105.1	1.9	93	6.6		25	
Allegheny River at mouth, Pittsburgh, Pa.	A 1.7	Sept. 16, 1940	2,700	20.0	5.9	63.9	3.0	363	6.8	10	23	118
Do	do	Sept. 25, 1940	3,790	21.5	2.0	22.7	5.8	2,400	6.8	8	21	123
Do	do	Oct. 4, 1940	3,240	18.0	3.1	32.1	5.4	930	6.7	12	40	102
Do	do	Oct. 9, 1940	2,760	19.0	3.8	40.1	[2] 1.8; 1.8	240	4.7	10		112
Do	do	Oct. 18, 1940	2,800	16.0	2.6	26.0	7.0	930	6.8	10	23	132
Allegheny River at mouth, Pittsburgh, Pa.	A 1.7	Oct. 23, 1940	2,800	13.5	4.4	42.4	4.1	230	6.5	7	17	116
Do	do	Nov. 1, 1940	9,300	13.5	5.5	52.9	4.1	763	6.9	6	14	124
Do	do	Nov. 6, 1940	8,660	10.5	10.9	97.4	2.1	230	6.9	6	18	130
Do	do	Nov. 13, 1940	9,300	8.5	11.6	98.5	2.1	230	7.0	16	35	100
Do	do	Nov. 27, 1940	15,200	6.0	13.5	108.3	2.3	430	7.0	12	27	90
Do	do	Dec. 4, 1940	22,700	1.0	15.8	110.8	1.6	36	6.7	12	19	71
Do	do	Dec. 10, 1940	39,800	1.5	14.8	105.6	1.8	43	6.7	90	22	76

[1] Less than 1.
[2] Seeded and neutralized.

TABLE A-7A.—*Allegheny River Basin: Laboratory data—Acid stream results*

Stream	Sampling point	Month 1940	Number samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Elk Creek, mile 181	Above St. Marys, Pa., mile 193.5	September	1	3.1	118	236	188	6	60
		October	1	3.1	198	322	278	9	80
		November	1	3.1	428	486	472	15	100
Toby Creek, mile 172	Above Brockway, Pa., mile 184.5	September	1	3.2	98	118	102	1.4	40
		October	1	3.0	108	124	102	.7	60
		November	1	3.1	92	128	88	1.8	40
	Below Brockway, Pa., mile 182.5	September	1	3.4	66	182	178	1.0	18
		October	1	3.0	136	160	140	.3	25
		November	1	3.1	134	166	166	1.8	22
	Mouth, mile 172	September	1	3.2	144	234	188		4
		October	1	3.0	244	284	256	.3	6
		November	1	3.2	170	284	262	.5	12
Clarion River, mile 86.1	Portland Mills, Pa., mile 173	October	1	4.7	32	56	48	.2	4
Soldiers Run, mile 129	Above Reynoldsville, Pa., mile 132.	do	2	3.0	295	379	358	3.0	108
Sugar Camp Run, mile 127	Sykesville, Pa., mile 127.5	do	1	6.3	144	228	208	50	175
Stump Creek, mile 121	3 miles below Sykesville, Pa., mile 124.	do	1	5.8	146	262	262	9	75
Mahoning Creek, mile 56.2	Above Punxsutawney, Pa., mile 113.	do	1	4.7		55	40	.2	2
	Below Punxsutawney, Pa., mile 109.	do	1	5.2		34	34	.4	4
Craig Run, mile 62.5	Mouth, Rural Valley, Pa., mile 62.5.	September	1	3.1	197	355	317	6.0	57
		October	1	2.8	253	382	312	13.5	44
		November	1	3.3			292	44	88
Cowanshannock Creek, mile 48.5	Above Rural Valley, Pa., mile 63	September	1	2.9	300	377	367	8	57
		October	1	2.8	354	489	434	20	125
		November	1	3.3			482	13	42
	Below Yatesboro, Pa., mile 60	September	1	3.2	162	249	216	9	34
		October	1	2.9	248	398	334	38	75
		November	1	3.5			116	15	46
North branch Plum Creek, mile 73	Above Sagamore, Pa., mile 78	September	1	3.2	64	84	75		2
		October	1	2.9	104	158	136	1.3	8
		November	1	4.0			24		4
	Below Sagamore, Pa., mile 77	September	1	3.2	102	138	129	6.5	18
		October	1	3.6	87	205	172	35	42
		November	1	3.9			67	16.5	24

Conemaugh River, mile 57	Above Lilly, Pa., mile 136.5	July	2	3.4	[1]45	[1]108	67	[1]5.8	
		August	1	4.1	26	67	45		2.4
	Below Lilly, Pa., mile 135.5	July	2	3.0	112	178	145	[1]8.2	11
		August	1	3.0			106		12
	Above Portage, Pa., mile 131	July	2	3.0	199	314	249	[1]6.2	33
		August	1	3.0			328	2.2	44
Trout Run, mile 130	Mouth, Portage, Pa., mile 129	July	2	2.6	541	855	687	7.5	135
		August	1	2.7				7	240
Conemaugh River, mile 57.0	Above Portage, Pa., mile 131	July	2	2.6	202	318	208	4.4	32
		August	1	2.7			236	2.3	30
	Above South Fork, Pa., mile 123	July	2	2.9	272	411	355	[1]77.5	[1]120
		August	1	2.9			182		11.5
	Below South Fork, Pa., mile 122	July	2	2.8	230	347	285	[1]22.4	42
		August	1	3.0			299	1.8	37
South Fork Creek, mile 122	Above South Fork, Pa., mile 124	July	2	2.8	406	650	545	65	153
		August	1	2.7			675	17	164
Shade Creek, mile 122	Below Central City, Pa., mile 134	July	2	4.4	9	22	20		3.0
		August	1	4.0			16		6.6
	Below Ritz, Pa., mile 132	July	2		138	248	171	4.4	35
		August	1				290	4.6	48
	Mouth, Seanor, Pa., mile 123	July	2	3.1	50	85	72		11
		August	1	2.8			151		14
Stony Creek, mile 109.5	Stoyestown, Pa., mile 135.5	August	1	3.6			27		3.3
	Above Hooversville, Pa., mile 131.5.	July	1	5.2		12	6		1.8
		August	1	3.5			35		2.6
	Below Hooversville, Pa., mile 129.5.	July	2	4.6	[1]6	20	15		3.5
		August	1	3.3			67		2.8
Quemahoning Creek, mile 125	Above Boswell, Pa., mile 133	July	2	3.6	59	93	76		6
		August	1	2.9			170		22
	Below Boswell, Pa., mile 132	July	2	3.9	47	88	70		7
		August	1	2.9			212		26
Stony Creek, mile 109.5	Above Holsopple, Pa., mile 124	July	2	4.2	8	19	14		3
		August	1	3.3			63		2.6
	Below Holsopple, Pa., mile 123	July	2	4.4	7	18	15		2.8
		August	1	3.4			58		2.6
Paint Creek, mile 119	Above Windber, Pa., mile 125	July	2	3.6	44	75	59		2.7
		August	1	3.6			69		23
	Mouth, Scalp Level, Pa., mile 119	July	2	2.8	222	340	286	15	38
		August	1	2.9			365	7	64
Stony Creek, mile 109.5	Above mouth Paint Creek, Scalp Level, Pa., mile 119.	July	2	3.4	31	50	42	[1]2.8	11
		August	1	2.9			121		17
	Above Ferndale, Johnstown, Pa., mile 113.5.	July	1	3.4	25	43	36		26
		August	2	2.8			191		15
	Mouth, Johnstown, Pa., mile 109.5	July	2	3.0	78	114	94	[1]1.8	66
		August	1	2.9			167		50
Conemaugh River, mile 57.0	Above Johnstown, Pa., mile 113	July	2	2.8	243	375	302	[1]12.6	28
		August	1	2.8			362		125
	Above mouth Stony Creek, mile 110.	July	2	4.2	51	128	93	13.2	43
		August	1	4.1			98	5	68

[1] 1 sample.

TABLE A-7A.—*Allegheny River Basin: Laboratory data—Acid stream results*—Continued

Stream	Sampling point	Month 1940	Number samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Conemaugh River, mile 57.0	Below Johnstown, Pa., mile 108	July	2	4.2	31	64	52	7.6	28
		August	1	3.9			89	4.2	26
	Above Seward, Pa., mile 101	July	1	3.8	82	163	127	8.6	10
		August	2	3.6	[1]39	[1]94	79	[1]3.6	9
	Bolivar, Pa., mile 87	July	1	3.7	57	120	96		2.5
		August	2	3.4	[1]39	[1]77	72		4.4
	Above Blairsville, Pa., mile 79	August	1	3.1	64	116	83	1.3	8
		October	1	3.5	52	112	79		2.8
		November	1	4.6			48	7.8	12.0
	Below Blairsville, Pa., mile 76	August	1	3.1	65	114	85		12
		October	1	3.5	63	110	72	.5	8.8
		November	1	4.6			42	10.5	16.0
South Branch Blacklick Creek, mile 105.	Above Nanty Glo, Pa., mile 113	July	1	2.7	550	765	652		122
		August	2	3.0	[1]1,400	[1]3,410	3,295	1,275	1,600
	Below Nanty Glo, Pa., mile 110	July	1	2.6	683	968	856	21.7	220
		August	2	2.6	[1]746	[1]1,012	1,001	38	235
	Above Vintondale, Pa., mile 106	July	1	2.4	813	1,132	1,062	17.5	245
		August	2	2.6	[1]810	[1]1,047	1,017	2.7	222
North Branch Blacklick Creek, mile 105.	Above Vintondale, Pa., mile 105	July	1	2.6	657	871	796	21	160
		August	2	[1]2.8	[1]270	[1]377	418	[1]4.7	67
Blacklick Creek, mile 73.5	Below Vintondale, Pa., mile 104	July	1	2.5	702	916	806	9	152
		August	2	2.6	[1]432	[1]602	604	[1]8	102
Dixon Run, mile 102	Mouth, Clymer, Pa., mile 102	September	1	3.7	33	68	48	6	25
		October	1	3.3	126	248	175	23	24
		November	1	4.3			52	14.5	23
Two Lick Creek, mile 83	Above Homer City, Pa., mile 88	September	1	3.1	112	148	131		1
		October	1	3.7	98	197	127		5
		November	1	3.7			58		6
	Below Homer City, Pa., mile 87	September	1	3.0	101	121	118		7
		October	1	3.3	100	144	128		10
		November	1	3.8			35		7
Yellow Creek, mile 88	Water plant, Homer City, Pa., mile 88.	September	1	3.3	102	125	114		12
		October	1	3.4	60	99	74		3
		November	1	3.7			29		12
Two Lick Creek, mile 83	Mouth, Josephine, Pa., mile 83	September	1	3.1	141	195	162		21
		October	1	2.9	191	298	236		35
		November	1	3.4			101	1.8	19
Blacklick Creek, mile 73.5	Above Blacklick, Pa., mile 82	August	1	2.6	395	559	458	.8	110
		October	1	2.6	585	780	703	2.8	93
		November	1	3.3			199	7.4	23

	Below Blacklick, Pa., mile 81	August	1	2.7	422	572	511	1.6	115
		October	1	2.4	612	788	739	2.0	98
		November	1	3.2			208	8.0	23
Conemaugh River, mile 57.0	Water plant, Saltsburg, Pa., mile 58.	August	1	2.9	146	219	174		22
		October	1	2.8	176	242	205		26
		November	1	3.9			69	6.4	20
Mill Creek, mile 90	Mouth, Ligonier, Pa., mile 91	September	1	2.9	87	124	101		13
		October	1	2.9	210	294	255	2.6	35
Loyalhanna Creek, mile 57	Below Ligonier, Pa., mile 89.5	September	1	4.7	3	9	14		3
		October	1	3.3	90	148	122	3.4	16
	Above Latrobe, Pa., mile 82.5	October	1	4.5	12	27	20		3
Saxman Run, mile 82	Above Bradenville, Pa., mile 85	September	1	4.3	25	41	39		7
		October	1	3.5	62	100	81		8
	Below Bradenville, Pa., mile 84	September	1	4.2	19	42	32		7
		October	1	3.6	53	99	75		2.6
Loyalhanna Creek, mile 57	Below Latrobe, Pa., mile 78	September	1	3.5	94	128	118	22	46
		October	1	3.1	217	469	452	87.4	110
Crabtree Creek, mile 71	Above Crabtree, Pa., mile 73	September	1	4.0	223	328	276		4
		October	1	4.2	143	242	196		2
	Below Crabtree, Pa., mile 72	September	1	2.6	2,340	3,110	3,010	255	591
		October	1	3.1	1,910	2,930	2,460	180	494
Loyalhanna Creek, mile 57	Mouth, Saltsburg, Pa., mile 58	August	1	2.6	506	736	612		175
		October	1	2.6	494	608	571		79
		November	1	3.3			197	28	38
Kiskiminetas River, mile 30.2	Below Saltsburg, Pa., mile 56.5	August	1	2.9	143	225	184		16
		October	1	2.8	170	242	215		33
		November	1	3.3			113	15.2	18
Harper Run, mile 59	Below Iselin, Pa., mile 61	August	1	4.3	16	44	35		6
		October	1	2.9	338	413	388		70
		November	1	3.4			158		12
Kiskiminetas River, mile 30.2	Above Avonmore, Pa., mile 52.5	August	1	3.2	100	171	144	5.2	14
		September	1	3.0	146	249	181	4.0	16
		November	1	3.9			58	1.3	18
	Above Salina, Pa., mile 50	August	1	3.0	119	173	148	2.6	13
		September	1	2.8	157	236	196	3.0	16
		November	1	3.5			63		17
	Below Salina, Pa., mile 49	August	1	3.0	118	172	146	3.4	13
		September	1	2.9	159	240	189	4.0	16
		November	1	3.7			56	.7	19
	Above Apollo, Pa., mile 45	August	1	2.9	119	167	151	2.6	18
		September	1	2.9	163	226	189	2.5	16
		November	1	3.7			67	2.6	18
	Above Vandergrift, Pa., mile 40.5	August	1	2.9	126	173	159	6.6	18
		September	1	2.8	158	230	190	.4	17
		November	1	3.7			68	8.5	20
	Leechburg, Pa., near Brady Run, mile 36.5.	August	1	3.0	127	203	178	10.4	22
		September	1	2.9	129	193	157	1.2	11
		November	1	4.1			84	8.5	18

[1] 1 sample.
[2] 3 samples.

TABLE A-7A.—*Allegheny River Basin: Laboratory data—Acid stream results*—Continued

Stream	Sampling point	Month 1940	Number samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Kiskiminetas River, mile 30.2	West Leechburg, Pa., Hyde Park, mile 34.5.	August	1	3.1	122	197	176	12.4	22
		September	1	3.0	128	199	160		12
		November	1	3.9			82	13.0	21
	Mouth, Freeport, Pa., mile 31	August	1	2.9	177	252	221	2.3	22
		September	3	2.9	166	221	194	[2] 2.7	30
		October	5	2.9	200	282	278	9.8	38
		November	3	3.3	74	138	107	6.1	27
		December	2	3.6	[1] 43	[1] 80	60	3.7	32
Allegheny River	Lock and dam No. 4, mile 24.2	August	2	4.3	14	33	30		.5
		October	2	5.6	5	13	14	[1] 6	7.5
	Lock and dam No. 3, mile 17	August	2	4.4	10	29	20		.5
		October	1	5.7	3	10	12		.7
	Lock and dam No. 2, mile 6.7	August	1	4.4	9	24	18		.2
	Mouth, Pittsburgh, Pa., mile 1.7	October	1	4.7	4	10	11		2.4

[1] 1 sample.
[2] 2 samples.

MONONGAHELA RIVER BASIN

CONTENTS

	Page
Contents	357
Syllabus and conclusions	359
Description	361
Presentation of field data	362
Presentation of laboratory data	366
Hydrometric data	369
Discussion	372

LIST OF TABLES

Mo–1.—Cost estimates of remedial measures	361
Mo–2.—Surface water supplies	363
Mo–3.—Sources of pollution	364
Mo–4.—Industrial wastes	365
Mo–5.—Selected laboratory data	366
Mo–5a.—Selected laboratory data (chemical results)	368
Mo–6.—Monthly mean summer flows	370
Mo–7.—Summary of laboratory results	375
Mo–7a.—Summary of laboratory results on acid streams	402

LIST OF FIGURES

Mo–1. Map—Sources of pollution	359
Mo–2. Chart—Sources of pollution and selected laboratory data	364
Mo–3. Map—Coliform results	368
Mo–4. Map—Dissolved oxygen results	368
Mo–5. Map—Biochemical oxygen demand results	368
Mo–5a. Map—pH results	368
Mo–6. Chart—Summer low-flow frequency curve	371

Fig. Mo-1

Fig. Mo-1
MONONGAHELA BASIN
SOURCES OF POLLUTION

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Mo-1

GPO-43 O-90035

MONONGAHELA RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Monongahela River drains about 7,380 square miles in Pennsylvania, West Virginia, and a small section of Maryland. The area is rugged and includes a number of large cities and an important coal mining industry. The main stream is extensively used for navigation. Flood-control reservoirs on Tygart (operated since 1938) and Youghiogheny (under construction) Rivers are used also to increase minimum flows. The distinguishing characteristic of this basin is the high acidity of the streams due to coal mine drainage. Almost half of the basin's total organic pollution load enters in the lower 15.6 miles. Surface water is used as a source of all major water supplies. The high acidity of the stream has served as a deterrent to the abatement of organic and bacterial pollution and the amount of sewage treated is negligible. With sewage treatment and no acid control, the streams would be suitable for only limited use. , Damage caused by mine drainage is substantial and the demonstrated success of acid control at the mine by sealing has indicated a promising line of attack. Flow regulation is a valuable supplementary control measure. A mine sealing—flow regulation acid control program for the area above the Ohio-West Virginia-Pennsylvania line is summarized in the acid mine drainage section of the report.

CONCLUSIONS

(1) Of 153 water supplies, 98, including all of the larger supplies, are from surface sources. Acidity from coal mine drainage presents corrosion and water treatment problems at the major supplies.

(2) Sewage from 862,000 people, industrial waste equal to the sewage from an additional 426,000 people and 646,000 tons of mine acid per year or about 1,770 tons per day enter the streams of the basin. Of the combined organic pollution load, 49 percent enters the stream in the lower 15.6 miles below the Youghiogheny River. Municipal sewage treatment reduces the total pollution load from 1,288,500 to 1,254,700, about 2.6 percent.

(3) Laboratory data indicate that the major problem is one of acid mine drainage rather than one of organic pollution. However, at the time of sampling, organic pollution appeared to be a factor at Clarksburg and Weston, W. Va., and Mt. Pleasant, Waynesburg, Jeannette (industrial waste) and Greensburg (one outlet), Pa.

(4) The original acid load from mine drainage is estimated at 920,000 tons per year (to phenolphthalein hot) of which 274,000 tons per year or nearly 30 percent has been removed by sealing, leaving 646,000 tons per year. The acid concentration of 87.5 tons per square mile per year in this basin is greater than in any other major Ohio River tributary basin.

(5) A program for acid reduction involving mine sealing supplemented by flow regulation is outlined in the section of the report on Acid Mine Drainage. Expenditures to date for mine sealing in this basin are estimated at $1,820,000. The next step in the mine sealing program is completion of sealing of mining areas not connected to active ventilation systems at mines where sealing costs will not exceed $10 per ton of acid sealed per year. Estimated costs of this program total $1,600,000.

(6) Acid conditions can be further improved and mine sealing supplemented by flow regulation from a storage of 370,000 acre-feet in the Monongahela Basin.

(7) The free acid from waste pickle liquor from the steel industry exclusive of acid iron salts totals 28 tons per day or only 1.6 percent of the mine acid load. Iron salts increase the acid effect to some extent. Cost estimates include part-time treatment of these wastes and this expenditure will be justified after success is attained in reducing mine acid.

(8) The problem of municipal sewage treatment at Pittsburgh is discussed in the section of the report on the main Ohio River. Low-flow regulation from reservoirs in the Monongahela River Basin will be of value in reducing treatment costs, notably at Pittsburgh and Cincinnati.

(9) Justification for treatment and the degree of treatment of sewage and organic industrial waste in many cases is dependent upon the status of mine acid reduction measures. The situation varies with the degree of acidity of the stream and the amount of organic pollution discharged. At some places the need for waste treatment is urgent and at others the first expenditures of public funds can be made to best advantage toward furthering the acid reduction program. In general, cost estimates apply to a comprehensive program that will be justified in parallel with extensive acid control measures.

(10) In conjunction with an effective acid control program, primary treatment is indicated at the cities along the Monongahela River to improve conditions at the sewer outfalls by eliminating floating matter and preventing sludge deposits, and to protect the many downstream public water supplies. In some instances the need is urgent regardless of acid control.

(11) At Elkins, Clarksburg, and Weston, W. Va., acidity is low and secondary treatment appears justified regardless of the status of an acid control program. At Greensburg, Uniontown, and a number of additional smaller communities on highly acid streams, secondary treatment will ultimately be required but primary treatment, now installed at Uniontown, is all that is justified in the absence of acid control.

(12) Cost estimates of remedial measures, exclusive of mine sealing and reservoir construction and exclusive of the Pittsburgh district are given in table Mo–1. These costs are based on treatment justified with a parallel program of acid control. Lack of an acid control program will greatly limit possible stream restoration. Table Mo–1 is summarized as follows:

Treatment	Capital cost	Annual cost
Existing	$1,500,000	$115,000
Suggested additional	13,250,000	1,455,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin, are:

Treatment	Capital cost	Annual cost
Primary, all places	$12,710,000	$1,385,000
Secondary, all places	15,950,000	1,785,000

TABLE Mo-1.—*Monongahela River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	13	7	66,100	$1,500,000	$90,000	$25,000	$115,000
Suggested minimum correction:							
Sewage treatment plants	66	16	776,200	6,270,000	440,000	270,000	710,000
Required interceptors	76			5,870,000	275,000		275,000
Independent industrial waste correction				1,110,000	150,000	320,000	470,000
Total				13,250,000	865,000	590,000	1,455,000
Comparative cost:							
Primary treatment, all waste				12,710,000	830,000	555,000	1,385,000
Secondary treatment, all waste				15,950,000	1,055,000	730,000	1,785,000
As suggested				13,250,000	865,000	590,000	1,455,000

NOTE.—Costs shown above do not include the cost of interceptors or treatment works for the city of Pittsburgh or its suburbs whose wastes would probably be treated at a plant along the Ohio River.

DESCRIPTION

The Monongahela River originates in northern West Virginia at the confluence of the Tygart and West Fork Rivers, and flows in a northerly direction to Pittsburgh, Pa., where it joins the Allegheny River to form the Ohio River. The drainage basin comprises a total of 7,380 square miles, of which 57 percent is in West Virginia, 38 percent is in Pennsylvania, and 5 percent is in Maryland. The basin lies entirely in the Appalachian Plateau region and is characterized by rugged topography with narrow stream valleys several hundred feet below the level of the uplands. Most of the cities are in the valleys. Populations exclusive of Pittsburgh proper but including the Monongahela Basin portion of Allegheny County are as follows:

	Populations, 1940		
	Urban	Rural	Total
State:			
West Virginia	107,154	241,028	348,182
Pennsylvania	477,977	423,869	901,846
Maryland	0	14,646	14,646

	Populations			
	1910	1920	1930	1940
Larger cities:				
Clarksburg, W. Va	9,201	27,869	28,866	30,579
Fairmont, W. Va	9,711	17,851	23,159	23,105
Duquesne, Pa	15,727	19,011	21,396	20,693
McKeesport, Pa	42,694	46,781	54,632	55,355
Wilkinsburg, Pa	18,924	24,403	29,639	29,853
Uniontown, Pa	13,344	15,692	19,544	21,819
Monessen, Pa	11,775	18,179	20,268	20,257
Pittsburgh, Pa	(1)	(1)	(1)	(1)
Total basin:				
Urban	346,843	479,903	578,209	585,131
Rural	564,933	614,437	646,575	679,543
Total	911,776	1,094,340	1,224,784	1,264,674

Major tributaries	River mile	Drainage area (square miles)
Youghiogheny River	15.6	1,768
Cheat River	89.1	1,424
Tygart River	128.1	1,369
West Fork River	128.1	882

[1] Not included.

Resources.—Natural resources of the basin consist of tillable land, coal deposits, and water power.

Industries.—Most important of the industries is the mining of coal, followed by the production of steel. Other industries include breweries distilleries, meat and dairy plants, and chemical works.

Water uses.—The Monongahela is canalized for its entire length by 14 low-lift locks and dams which provide navigable depths of 8 feet throughout the lower 90 miles and 7 feet for the remaining 38 miles. This river is one of the most intensively used inland waterways in the world. Three artificial reservoirs are intensively used for recreation as are many clean streams in the eastern part of the basin. Two large hydroelectric projects, on tributary streams, have been constructed by private interests.

Presentation of Field Data

Figure Mo–2 shows graphically the main stream and tributaries, waterworks intakes, dams, all major sources of organic pollution, their magnitude and reduction by present treatment, and other pertinent information. This figure does not show pollution of inorganic origin

such as acid mine drainage, pickle liquor, or chemical wastes. Selected laboratory data on the main Monongahela and West Fork Rivers also are shown.

Public water supplies.—Of 153 public water supplies, 5 are in Maryland, 90 in Pennsylvania, and 58 in West Virginia. Table Mo–2 shows a total of 98 surface supplies serving 811,200 persons, 37 in Pennsylvania and 20 in West Virginia from streams below community sewer outfalls. There are 55 ground-water supplies serving 67,000 persons, indicating that surface sources are used as major supplies. The acidity of surface waters presents unusual problems in treatment and corrosiveness. On the main stream 20 surface supplies have an average pH of 4.0 to 5.0 in the raw water.

TABLE Mo–2.—*Monongahela River Basin: Surface water supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
South Pittsburgh Water Co.	Pennsylvania	Monongahela River	4.0	LD	250,000	18.00
Braddock	do	do	10.5	LD	18,300	1.30
McKeesport	do	Monongahela and Youghiogheny Rivers.	16.6	LD	64,000	6.00
Elizabeth	do	Monongahela River	23.0	FD	30,000	2.60
Charleroi	do	do	42.5	FD	40,000	1.51
Trotter Water Co. "C"	do	do	77.1	FD	15,000	1.60
Morgantown	West Virginia	Monongahela impounded.	103.0	FZD	30,000	1.25
Uniontown	Pennsylvania	Youghiogheny and impounded.	61.5	FD	30,000	1.60
Trotter Water Co. "A"	do	Youghiogheny	62.0	FD	12,000	2.00
Connellsville	do	Youghiogheny and creeks.	62.1	FD	16,000	2.00
Fairmont	West Virginia	Tygart River	128.4	FD	30,000	2.29
Grafton	do	do	150.0	FD	4,000	1.50
Elkins	do	do	210.0	FD	8,500	1.14
Clarksburg	do	West Fork River	160.0	FZD	35,000	2.90
28 smaller supplies	Pennsylvania	Various		Various	81,000	3.46
15 smaller supplies	West Virginia	do		do	20,800	1.23
Total:						
Below sewer outfalls					684,300	50.38
Other					126,900	9.04
Total surface water supplies					811,200	59.42

[1] Miles above mouth of Monongahela River.
[2] F=Coagulated, settled, filtered; L=Lime-soda softened; Z=Zeolite softened; D=Chlorinated.

Sewerage.—Of the 145 sewered communities in the basin, 13 have primary and 7 secondary treatment for their domestic sewage. Treatment serves only about 8 percent of the total sewered population and reduces the total organic pollution load about 2.6 percent. Table Mo–3 summarizes the sources of significant organic pollution including industrial wastes expressed as equivalent sewered population.

TABLE Mo-3.—*Monongahela River Basin: Sources of significant pollution, including industrial waste expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	State	Receiving stream	Miles above mouth of Monongahela	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Pittsburgh [1] [2]	Pennsylvania	Monongahela River.	0-10	319,500	None	458,500	458,500
Braddock [2]	do	do	10.5	32,600	do	32,600	32,600
Duquesne [2]	do	do	12.0	21,100	do	21,100	21,100
McKeesport	do	do	14.2	55,000	do	61,700	61,700
Glassport	do	do	18	8,700	do	8,700	8,700
Clairton	do	do	20	16,000	do	156,000	156,000
Monongahela City	do	do	31.9	7,800	do	7,800	7,800
Donora	do	do	36.4	13,000	do	13,000	13,000
Monessen	do	do	40.0	18,000	do	18,000	18,000
Charleroi	do	do	42	10,500	do	10,500	10,500
Brownsville	do	do	56	7,000	do	7,000	7,000
Masontown	do	do	79.1	3,000	do	3,000	3,000
Morgantown	West Virginia	do	100.9	16,100	do	16,100	16,100
Fairmont	do	do	126.7	20,000	do	27,500	27,500
East Pittsburgh	Pennsylvania	Turtle Creek	12.0	17,300	do	17,300	17,300
Turtle Creek	do	do	12.5	9,600	do	9,600	9,600
Wilmerding	do	do	14.0	5,500	do	5,500	5,500
Pitcairn	do	do	15.5	6,100	do	6,100	6,100
Trafford	do	do	16.5	3,600	do	3,600	3,600
Irwin	do	do	24.0	3,400	do	3,400	3,400
Jeannette	do	do	29	14,500	Secondary	14,500	2,200
Port Vue	do	Youghiogheny River.	16.6	3,600	None	3,600	3,600
Connellsville	do	do	60	12,900	do	14,300	14,300
Ruffsdale	do	Sewickley Creek	49	0	do	3,100	3,100
Southwest Greensburg.	do	do	55	3,000	do	3,000	3,000
Greensburg	do	do	56	16,000	do	16,400	16,400
Scottdale	do	Jacobs Creek	54	6,300	do	6,300	6,300
Mount Pleasant	do	do	60	5,000	do	5,600	5,600
Somerset	do	Casselman River	118	5,400	Primary	11,100	9,400
Large	do	Peters Creek	23.5	0	None	90,000	90,000
Uniontown	do	Redstone Creek	73	25,000	Primary	27,000	17,500
Waynesburg	do	Ten Mile Creek	85	4,500	do	4,500	2,900
Parsons	West Virginia	Cheat River	167.5	2,000	None	12,900	12,900
Mannington	do	Buffalo Creek	142	3,100	do	3,100	3,100
Grafton	do	Tygart River	150	3,800	do	3,800	3,800
Elkins	do	do	209	8,100	do	23,100	23,100
Buckhannon	do	Buckhannon River.	205	4,300	do	4,300	4,300
Clarksburg	do	West Fork River	158.8	29,000	do	29,000	29,000
Weston	do	do	194	5,000	do	5,000	5,000
Smaller sources (108)[3].				116,900	Various	120,900	93,000
Total:							
Pennsylvania				727,800		1,120,300	1,089,900
West Virginia				131,400		165,200	161,800
Maryland				3,000		3,000	3,000
Total basin				862,200		1,288,500	1,254,700

[1] Pollution loads from Pittsburgh and suburbs are distributed to Allegheny and Monongahela Basins and Main Ohio River as follows:

Municipality	State	Receiving stream	Miles above mouth of Monongahela	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Pittsburgh and suburbs.	Pennsylvania.	Allegheny River	0-8	320,500	None	597,200	597,200
	do	Monongahela River.	0-10	319,500	do	458,500	458,500
	do	Ohio River	0-4 (below)	261,700	do	278,600	278,600
Total				901,700		1,334,300	1,334,300

[2] Includes waste from adjoining communities that reaches same outfall sewers.
[3] Excluding places of under 500 population or equivalent.

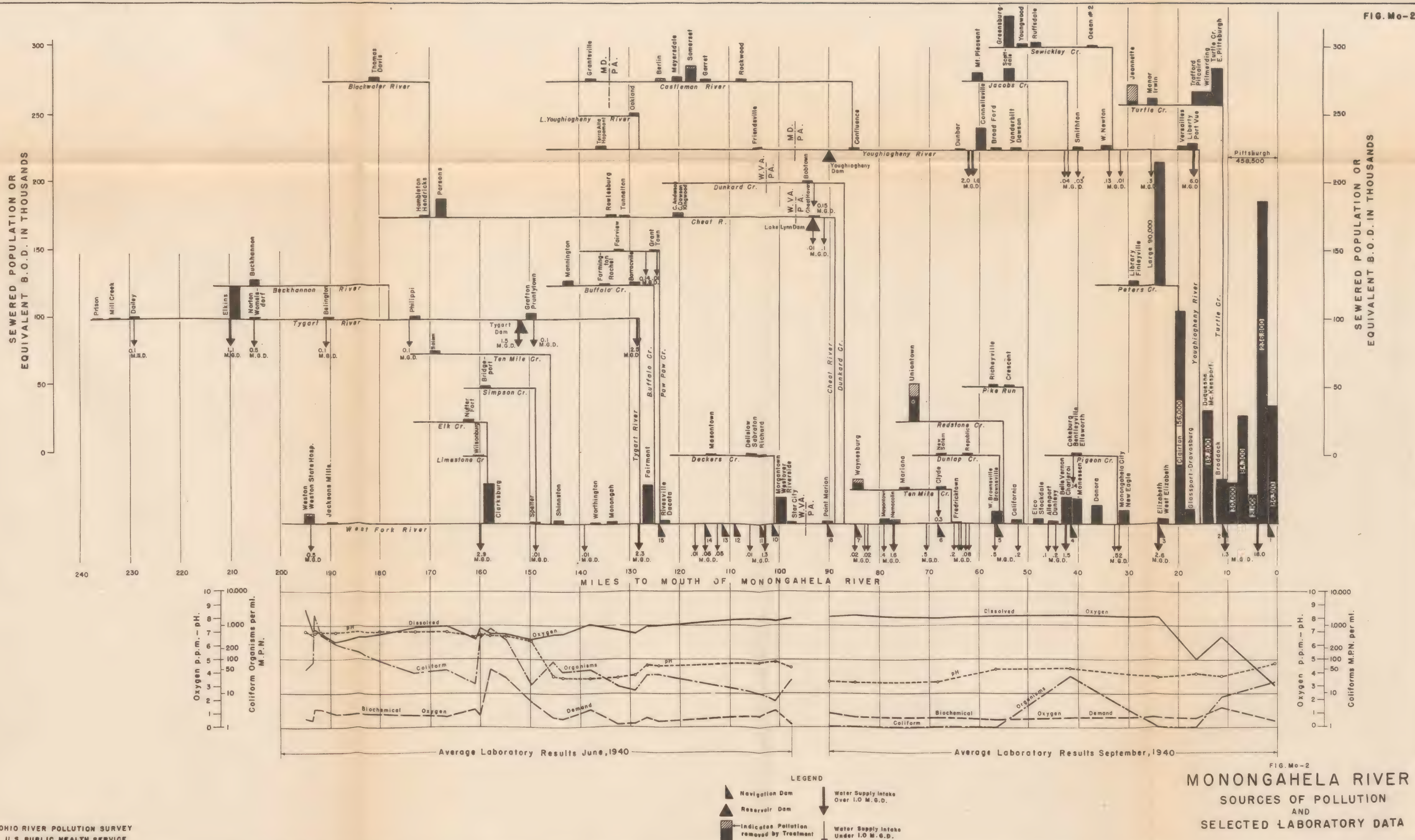


FIG. Mo-2
MONONGAHELA RIVER
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

GPO-43 O-90035

Industrial wastes.—Table Mo–4 summarizes pertinent information on waste-producing industries in the basin. The coke byproduct industry produces by far the largest organic pollution load. Distilling and brewing also produce significant organic waste loads. About one-third of the industries discharge all or part of their industrial waste to city sewer systems. Only one industrial waste receives treatment at a municipal treatment plant. Twenty-six industrial plants have taken at least minor corrective measures to reduce pollution, 20 of these being of an important and effective nature.

TABLE Mo–4.—*Monongahela River Basin: Summary of industrial wastes not discharging to municipal treatment plants with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand
		Municipal sewers	Private outlet		
Brewing	5	4	1	0	49,100
Byproduct coke	3	0	3	2	240,000
Chemical	3	0	3	0	----------
Distilling	3	0	3	2	94,000
Meat	6	4	2	4	6,100
Milk	5	3	2	2	3,300
Steel	26	4	22	12	----------
Tanning	2	0	2	2	25,000
Textile	2	0	2	0	1,000
Miscellaneous	31	6	25	2	5,800
Wastes unconnected municipal treatment	86	21	65	26	424,300
Waste discharged to municipal treatment					2,000
Total industrial waste in the basin					426,300
By States:					
Maryland					0
Pennsylvania					392,500
West Virginia					33,800

Metal industries are important chiefly because of pickle liquor discharges. In the Monongahela River Basin, free acid discharge from this source is estimated at 57,000 pounds or over 28 tons per day. This is only 1.6 percent of the mine acid load. Acid iron salts, having an acid effect, are not included in this figure and the comparison, although the best that can be made from the data available, involves acid figures which are not strictly comparable. However, it is apparent that acid mine drainage is by far the more important problem.

Mine drainage.—Acid mine drainage discharge in this basin has the greatest intensity in annual tons per square mile of all the major tributary basins of the Ohio River. Estimated acid loads as presented in the acid mine drainage section of the Ohio River Pollution Survey Report are as follows:

Description	Monongahela River except Youghiogheny	Youghiogheny River only	Total, Monongahela River
	Tons per year (to phenolphthalein—hot)		
Original acid load:			
Active mines	438, 274	141, 735	580, 009
Marginal mines	39, 064	25, 609	64, 673
Abandoned mines	223, 634	52, 340	275, 974
Total	700, 972	219, 684	920, 656
Per square mile	124. 1	126. 8	124. 7
Sealed mines	380, 026	29, 270	409, 296
Removed by sealing	251, 900	22, 742	274, 642
Present load	449, 072	196, 942	646, 014
Per square mile	79. 5	113. 7	87. 5
Additional removal [1]	115, 630	83, 050	198, 680
Future residual [2]	333, 442	113, 892	447, 334
Per square mile	59. 0	65. 8	60. 6

[1] Economical to remove in addition by sealing under 1940 restrictions with a cost limitation of $10 per ton of acid per year and sealing only in areas not connected to active ventilation systems.
[2] Capable of further reduction (possibly an additional 50 percent) by extended program.

Presentation of Laboratory Data

Complete summaries of routine laboratory results for the Monongahela River Basin are presented in table Mo–7 (p. 375). Summaries of special acid and chemical determinations are shown in table Mo–7A. (p. 402). These data were obtained in part from operations of mobile laboratories connected with the present survey and in part from the West Virginia State Water Commission. Observations were carried out during the period May to December 1940.

Selected average analytical results at some of the principal points in the basin are tabulated with stream flows on sampling days and with the minimum flows of record in table Mo–5. Selected results have been chosen for low dissolved oxygen, high coliform or low pH findings and, in general, represent the most unfavorable conditions during the sampling period. Selected average acid and chemical results are presented in table Mo–5A.

Table Mo–5.—*Monongahela River Basin: Selected Laboratory Data*

River	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela
Location	Mouth, Pittsburgh	Dam No. 2, Pittsburgh	Above Youghiogheny	Dam No. 3, McKeesport	Dam No. 4, Charleroi	Dam No. 5, Brownsville	Dam No. 6
River miles above mouth of Monongahela.	0.05	11.2	16.4	23.8	41.5	56.5	68.3
Period, 1940	September	August	August–September	September	August	August	September
Number of samples	2	2	4	1	2	2	4
Flow in cubic feet per second:							
Sampling days	2, 140	3, 200	1, 600	2, 100	1, 340	1, 170	1, 570
Minimum month	398		249				
Water temperature °C	22	22	23. 8	22	24. 2	24. 3	21. 1
Coliforms per milliliter	27	23	1	(1)	1	3	(1)
Dissolved oxygen, parts per million	3. 0	5. 7	5. 0	8. 1	7. 8	7. 6	8. 0
Biochemical oxygen demand, 5-day, parts per million	2. 1	. 7	. 8	. 9	. 9	. 5	. 8
pH	4. 7	3. 9	4. 0	3. 7	3. 3	3. 6	3. 6

TABLE MO–5.—*Monongahela River Basin: Selected Laboratory Data*—Continued

River	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela
Location	Dam No. 7	Dam No. 8, Port Marion	Star City	Morgantown, W. Va.	Lock No. 11, Morgantown	Below Fairmont	Fairmont
River miles above mouth of Monongahela.	84.8	90	97.7	100.9	104.1	124.2	126.7
Period, 1940	September	May	June	June	June	June	June
Number of samples	4	1	4	4	4	3	3
Flow in cubic feet per second:							
Sampling days	1,090	38,000	6,750	6,700	6,600	4,230	1,787
Minimum month					43		
Water temperature °C	21.6	16.0	22.7	22.5	22.7	23.0	23.0
Coliforms per milliliter	([1])	8	25	6	10	34	38
Dissolved oxygen, parts per million	8.2	9.6	8.0	7.8	8.0	7.0	7.3
Biochemical oxygen demand, 5-day, parts per million	1.0	.8	.2	1.2	.8	.4	.7
pH	3.4	5.0	4.4	4.9	4.8	4.5	4.6

River	Youghiogheny	Youghiogheny	Youghiogheny	Youghiogheny	Casselman	Casselman	Cheat
Location	Near mouth	Below Connellsville	Below Confluence	Below Oakland	Near mouth	Above Meyersdale	Near mouth
River miles above—							
Confluence with Monongahela.	0.7	31.4	68.9	111.9	71.4	100.4	0.9
Mouth of Monongahela	16.3	57	84.5	127.5	87	116	90
Period, 1940	August	August	July	June	July	July	June
Number of samples	2	1	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	1,810	2,490	640	299	219	72	13,400
Minimum month	113						
Water temperature °C	21.8	19.5	23.8	18.0	22.2	20.5	19.3
Coliforms per milliliter	5	2,400	21	48	4	38	11
Dissolved oxygen, parts per million	6.7	8.4	7.9	8.2	8.2	7.6	8.6
Biochemical oxygen demand, 5-day, parts per million	1.2	2.0	.6	.7	.5	1.3	1.0
pH	3.5	6.7	5.1	5.0	3.8	3.6	5.5

River	Cheat	Tygart	Tygart	Tygart	West Fork		
Location	Below Holly Meadows	Near Mouth	Below Grafton	Below Elkins	Near mouth	Below Clarksburg	Above Weston
River miles above—							
Confluence with Monongahela	76.4	3.9	18.6	77.4	0.9	29.9	66.9
Mouth of Monongahela	165.5	132	146.7	205.5	129	158	195
Period, 1940	June	June	June	July	June	June	June
Number of samples	3	3	3	4	3	3	3
Flow in cubic feet per second:							
Sampling days	2,890	5,220	5,210	472	979	1,057	116
Water temperature °C	16.7	19.8	19.5	18.8	24.0	23.0	21.7
Coliforms per milliliter	20	23	30	825	12	881	49
Dissolved oxygen parts per million	8.6	9.0	9.6	7.3	6.9	6.9	7.7
Biochemical oxygen demand, 5-day parts per million	.5	.5	.6	1.6	.7	4.4	.6
pH	6.8	6.7	6.7	6.9	3.8	6.7	7.1

[1] Less than 1.

TABLE Mo–5A.—*Monongahela River Basin: Selected laboratory chemical data*

River	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela	Monongahela
Location	Mouth	Above Youghiogheny	Lock No. 4	Lock No. 6	Lock No. 8	Lock No. 11	Below Fairmont
River miles above mouth of Monongahela.	0.05	16.4	41.5	68.3	90.6	104.1	124.2
Period, 1940	October	August–September	October	September	November	June	June
Number of samples	4	4	5	4	4	4	3
Flow in cubic feet per second:							
Sampling days	2,710	1,600	1,920	1,570	3,070	6,660	4,230
Minimum month	398 [1](1270)	249 [1](899)	----------	----------	----------	43 [1](713)	----------
pH	3.7	4.0	3.6	3.4	4.3	4.8	4.5
Acidity, parts per million:							
Methyl red	26	16	22	34	7	9	14
Phenolphthalein (hot)	43	37	35	45	15	19	20
Iron, total, parts per million	5.0	3.2	1.5	1.5	1.7	1.3	1.6
River	Youghiogheny	Youghiogheny	Casselman	Cheat	Blackwater	West Fork	West Fork
Location	Mouth	Below Oakland, Md.	Mouth	Mouth	Mouth	Mouth	Above Zeising, W. Va.
River miles above—							
Mouth of Monongahela	16.3	127.5	87	90	172	129	149.8
Confluence with Monongahela.	.7	111.9	71.4	.9	82.9	.9	21.7
Period, 1940	October	June	July	June	June	June	July
Number of samples	4	2	2	2	2	3	2
Flow in cubic feet per second:							
Sampling days	627	382	385	2,475	625	936	469
Minimum month	113	----------	----------	----------	----------	----------	----------
pH	3.6	5.3	3.9	5.0	4.8	3.9	5.2
Acidity, parts per million:							
Methyl red	45	----------	15	16	11	25	17
Phenolphthalein (hot)	76	14	28	32	22	46	41
Iron, total, parts per million	6.0	4.3	1.2	1.7	3.9	1.4	3.7

[1] After Tygart Dam installed.

Figures Mo–3, Mo–4, Mo–5, and Mo–5A show graphically the concentration of coliform organisms, dissolved oxygen, oxygen demand, and pH, respectively, at various sampling points throughout the watershed. These data are presented as averages of all the results where the sampling period was less than a month and as the most unfavorable monthly averages where observations extended over more than 1 month.

Stream discharges on the Monongahela varied from 62,000 second-feet in May to 830 second-feet in August at mile 85. During the May–July period, flows in the West Fork River at Clarksburg were 800 to 1,000 second-feet and the Tygart River discharges during the sampling period in June at Grafton were about 5,000 second-feet. Discharges from August to December were generally in the normal low-water ranges.

It appears, from an examination of the laboratory data, that the main problem in the Monongahela Basin is one of acid mine drainage rather than one of organic pollution. Organic pollution appeared to be a factor at Jeannette, Greensburg, Mount Pleasant, and Waynesburg, Pa., and East Salem, Clarksburg and Weston, W. Va. Of these, Waynesburg has a sewage-treatment plant under construction. The Cheat and Tygart Rivers were in generally good sanitary condition during the sampling period.

Fig. Mo-3

MONONGAHELA BASIN

COLIFORM RESULTS

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Mo-4

LEGEND

Average Dissolved Oxygen Results at Sampling Stations.

Symbol	Dissolved Oxygen p.p.m.
○	Over 6.5
◔	5.1 to 6.5
◑	3.1 to 5.0
●	0.1 to 3.0
●	0.0

Fig. Mo-4

MONONGAHELA BASIN

DISSOLVED OXYGEN RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

 GPO-43 O-90035

Fig. Mo-5

MONONGAHELA BASIN

BIOCHEMICAL OXYGEN DEMAND

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

GPO-43 O-90035

Fig. Mo-5a

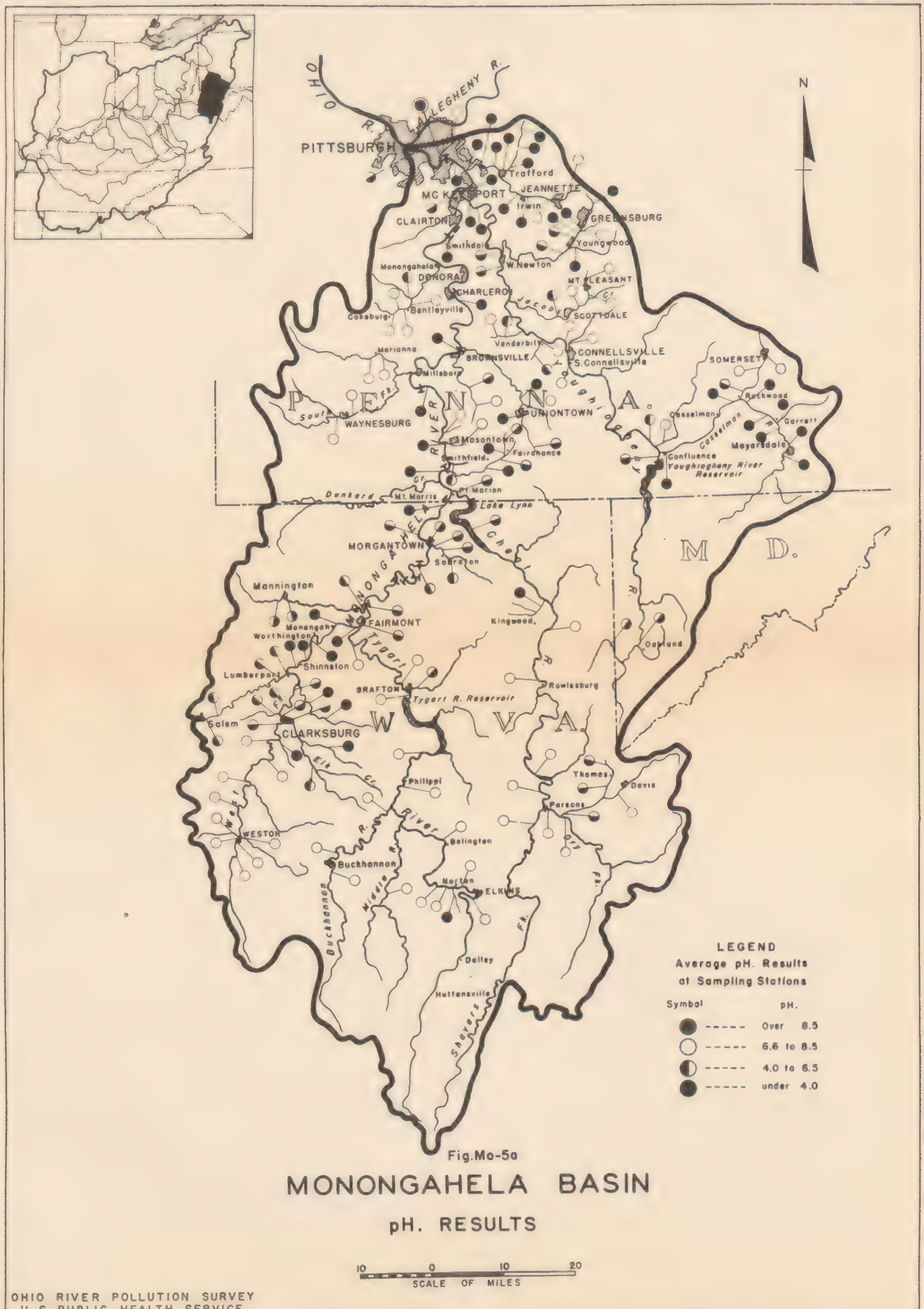


Fig. Mo-5a

MONONGAHELA BASIN

pH. RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

GPO-43 0-90035

As indicated by bacteriological findings, about 71 percent of the sampling stations above towns on normal streams (85 percent on acid streams) showed coliform organism concentrations of less than 200 per milliliter. The effect of acid stream conditions, as compared to normal stream conditions was, in general, to reduce the coliform counts.

The dissolved oxygen results show quite general average concentrations of 6.5 parts per million or more and 78 percent of all stations in the basin fall into this group. Oxygen depletion was observed only below Jeannette, Pa., in October and near depletion below Waynesburg, Pa., in August. pH values were above 7.0 at both points.

Over 70 percent of all stations had average oxygen demands of less than 3.0 parts per million under the most unfavorable conditions observed. About 25 percent of all stations sampled had oxygen demands in excess of 5.0 parts per million. Because of the effect of acid on normal biochemical oxidation, the biochemical oxygen demand tests on acid stream samples were carried out in duplicate; one portion being incubated in the acid state as collected and the other being incubated after neutralization with sodium hydroxide and seeding with filtered sewage. In general, the results of the two portions were either of the same order of magnitude or the acid portion showed a higher biochemical oxygen demand, in a few cases a great deal higher, than the neutralized portion. Ferrous iron may exert a chemical demand to further complicate interpretation.

The results of acid stream examinations on table Mo–7A show pH values ranging from 2.8 to 6.9, acidities from nearly zero to about 5,000 parts per million, and total iron from less than 1.0 parts per million to over 2,000 parts per million.

The presence of acid wastes makes the interpretation of much of the sanitary data gathered along the Monongahela Basin somewhat difficult and complicates the evaluation of the effects of the self-purification process. There was a general tendency for the acidity to decrease with increased stream discharge. This appeared to be the case both on the larger and the smaller streams. Increased stream discharges also tended to increase the coliform and dissolved oxygen concentrations and to decrease the oxygen demands in the smaller streams but apparently had little effect, so far as these factors are concerned, on the larger streams in the discharge ranges observed.

Biological Summary.—The acid condition of the main stream of the Monongahela renders it nearly devoid of plankton or fish life, except where clean tributaries join the main stream. The tributaries, Ten Mile Creek and Pigeon Creek, support a fair plankton and fish population.

Hydrometric Data

Twenty-two stream gaging stations with records of consequence have been maintained in the Monongahela River Basin at various times, of which 19 are currently in operation. Table Mo–6 shows monthly mean summer flows at 8 stations for 3 dry summers during the period of record. Flows on the Monongahela River and the lower Tygart River have been affected by Tygart Reservoir, completed in 1938. Figure Mo–6 indicates that the frequency with which minimum monthly mean summer flows have occurred and would have occurred with regulation by Tygart and Youghiogheny Reservoirs are as follows:

Regulation status	Minimum monthly mean summer flows in cubic feet per second that may be expected once in—			
	2 years	5 years	10 years	Minimum
Youghiogheny River at Connellsville, Pa.:				
Unregulated	480	270	180	85
Regulated by Youghiogheny Dam	1,340	990	800	600
Monongahela River at Charleroi, Pa.:				
Unregulated	3,150	1,300	750	250
Regulated by Tygart Dam	3,550	1,550	950	400

TABLE Mo-6.—*Monongahela River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River / Location	Monongahela Charleroi, Pa.	Turtle Creek Trafford, Pa.	Youghiogheny Connellsville, Pa.	Cheat Parsons, W. Va.
River miles above—				
Confluence with Monongahela		5.5	44.4	78.4
Mouth of Monongahela	42	16.5	60	167.5
Drainage area, square miles	5,213	54.8	1,326	719
Period of record	1933–39	1916–39	1909–39	1913–39
Year	1936	1932	1939	1930
June, cubic feet per second	1,345	3.59	1,974	573
July, do	1,337	2.37	1,571	89.3
August, do	2,172	.96	285	34.9
September, do	911	[1] .56	[1] 85.2	[1] 23.3
Year	1934	1930	1910	1932
June, cubic feet per second	1,009	48.9	5,229	496
July, do	4,296	4.37	575	1,560
August, do	1,501	.95	100	376
September, do	[1] 475	1.22	218	87.9
Year	1939 [2]	1922	1914	1936
June, cubic feet per second	7,488	25.3	1,230	305
July, do	7,471	58.8	536	1,340
August, do	2,280	2.49	323	475
September, do				

River / Location	Cheat Pisgah, W. Va.	West Fork Enterprise, W. Va.	West Fork Clarksburg, W. Va.	Tygart Belington, W. Va.
River miles above—				
Confluence with Monongahela	18	13.0	30.7	61.9
Mouth of Monongahela	107.1	141.1	158.8	190
Drainage area, square miles	1,360	759	384	408
Period of record	1928–39	1907–16, 1933–39	1923–39	1907–39
Year	1930	1908	1930	1930
June, cubic feet per second	1,440	157	15.6	151
July, do	251	162	5.24	21
August, do	74.4	103	4.95	2.5
September, do	[1] 43.4	[1] 19.8	4.35	[1] .65
Year	1932	1910	1932	1932
June, cubic feet per second	665	798	16.9	205
July, do	1,960	342	176	812
August, do	544	25.4	57.8	160
September, do	115	454	[1] 3.89	12.9
Year	1936	1936	1936	1908
June, cubic feet per second	484	30.7	7.48	388
July, do	1,930	254	73.5	391
August, do	784	136	107	83.8
September, do	221	38.5	26.2	17.2

[1] Minimum month.
[2] Regulated by Tygart Reservoir.

Fig. Mo-6

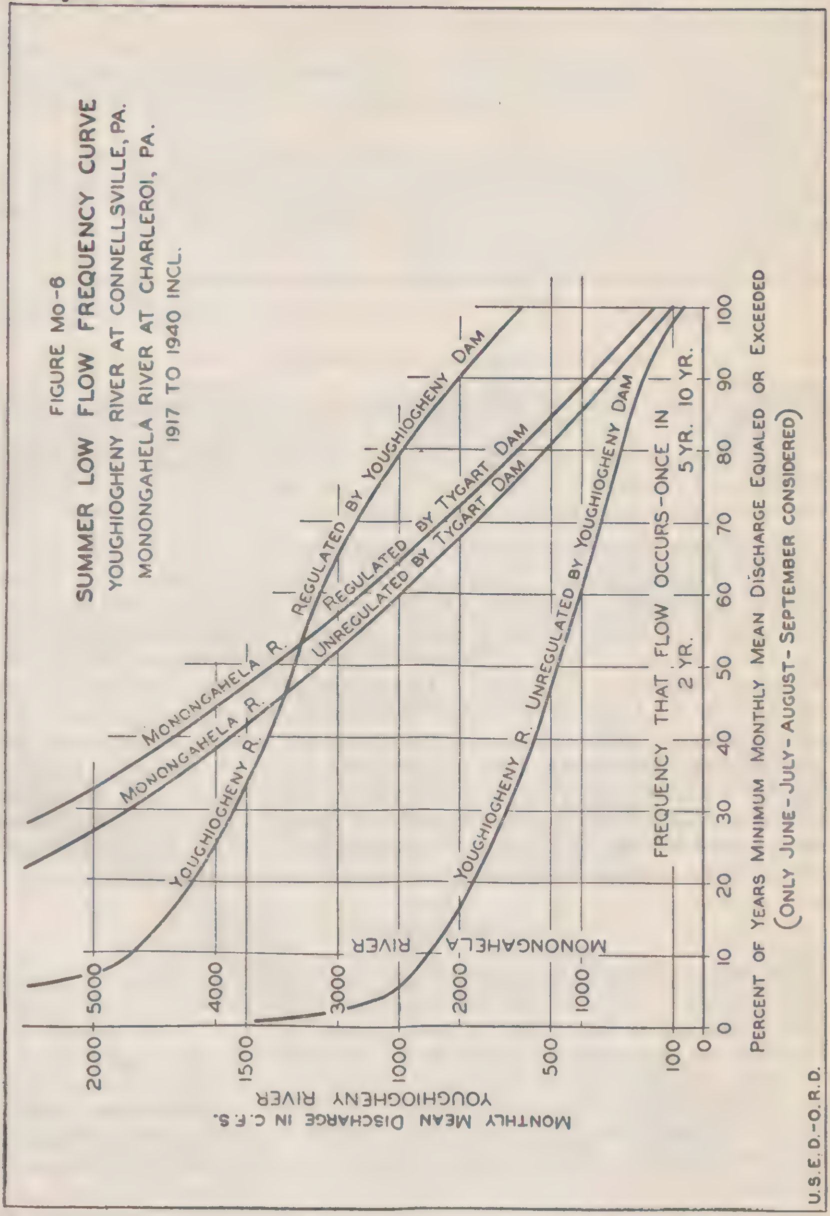


FIGURE Mo-6
SUMMER LOW FLOW FREQUENCY CURVE
YOUGHIOGHENY RIVER AT CONNELLSVILLE, PA.
MONONGAHELA RIVER AT CHARLEROI, PA.
1917 TO 1940 INCL.
MONONGAHELA R. REGULATED BY TYGART DAM
MONONGAHELA R. UNREGULATED BY TYGART DAM
YOUGHIOGHENY R. REGULATED BY YOUGHIOGHENY DAM
YOUGHIOGHENY R. UNREGULATED BY YOUGHIOGHENY DAM
FREQUENCY THAT FLOW OCCURS-ONCE IN 2 YR. 5 YR. 10 YR.
MONONGAHELA RIVER
5000 4000 3000 2000 1000
YOUGHIOGHENY RIVER
2000 1500 1000 500 100 0
MONTHLY MEAN DISCHARGE IN C.F.S.
0 10 20 30 40 50 60 70 80 90 100
PERCENT OF YEARS MINIMUM MONTHLY MEAN DISCHARGE EQUALED OR EXCEEDED
(ONLY JUNE-JULY-AUGUST-SEPTEMBER CONSIDERED)
U.S.E.D.-O.R.D.

Low-flow regulation.—There are two private reservoirs of consequence on the basin used for power. Lake Lynn on the Cheat River below the proposed Cheat River Reservoir has a capacity of 72,300 acre-feet. Deep Creek Reservoir on a headwater stream of the Youghiogheny River has a capacity of 106,000 acre-feet. Both of these reservoirs are operated to produce peak-load power and are of limited benefit to the pollution problem. The normal fluctuating flows below peak-power reservoirs are undesirable from a standpoint of pollution abatement.

The following reservoirs in the basin have been built, are under construction, or have been studied by the United States Engineer Department in connection with the authorized program for Ohio River flood control:

Reservoir	Stream	Status	Storage (acre-feet)
Tygart River	Tygart River	Completed	278, 800
Youghiogheny	Youghiogheny River	Under construction	249, 000
Cheat River	Cheat River	Proposed	890, 000
West Fork above—			
Clarksburg	West Fork	do	61, 200
Brownsville	do	do	101, 500
Elk Creek	Elk Creek	do	114, 500

The Tygart Reservoir is being operated to provide low-flow control and the Youghiogheny Reservoir will be so operated. The major value to pollution abatement of these reservoirs and of the proposed reservoirs is in supplementing mine sealing for the control of acidity. The value of such flow regulation is discussed in the section of the report on Acid Mine Drainage. In addition, they could aid in abating pollution in the Ohio River below Pittsburgh due to sewage and other organic wastes. Except for the reservoirs on the West Fork and Elk Creek above Clarksburg, flow augmentation by the proposed projects would have no appreciable tangible value for the abatement of organic pollution within the Monongahela River Basin. The West Fork Reservoir could also be of value in insuring the adequacy of Clarksburg's public water supply, which suffered a serious shortage in 1930.

Discussion

The major problem in this basin is the control of acidity from acid mine drainage which enters the streams. The demonstrated success of acid control at the mine by sealing has indicated a promising line of attack on the mine-acid problem. In addition, flow regulation is a valuable supplementary control measure. A discussion of this problem, concluding with the presentation of a mine sealing—flow regulation acid control program for the area above the Ohio-West Virginia-Pennsylvania line, will be found in the acid mine drainage section of the report.

Stream restoration requires control of all types of pollution and up to the present time uncorrected acid mine pollution has served as a deterrent to organic pollution abatement. The germicidal and chemical coagulating action of the acid and iron salts may greatly reduce acute odor and nuisance conditions during normal times, and this

point has been the subject of considerable discussion. However, sludge deposits, visual nuisance from floating sewage materials, and odors are present at and below sewer outlets. Water supplies from the river below have no dependable safeguard because of fluctuations in acidity and the possible sudden elimination of nearly all acid during high flows. Damages from acid conditions in the upper Ohio Basin are estimated at over $2,000,000 per year, excluding unevaluated and intangible damages believed at least to equal the tangible damages.

In considering stream restoration in mine acid areas, mine acid control and organic pollution abatement should be carried on as parallel programs. Both measures are necessary if complete restoration is to be obtained. A single measure may be amply justified in individual cases but maximum benefits are possible only when the two programs are carried on in parallel. The suggested program of sewage and industrial waste treatment outlined herein will be fully justified only in conjunction with a comprehensive acid-reduction program.

PITTSBURGH AND VICINITY

At present, nearly all of the sanitary sewage and industrial wastes from Pittsburgh and vicinity are discharged directly into the creeks and rivers, causing unsightly and malodorous conditions along all water fronts. This area receives the largest pollution load in the basin, aggregating a total of about 460,000 sewered population equivalent. The Pittsburgh problem is discussed and cost estimates are included under the main Ohio River. Effective chemical treatment at a site or sites, chiefly on the Ohio River, appears feasible, or primary treatment, plus maintenance of increased summer flow below Pittsburgh, offers a promising alternate solution.

YOUGHIOGHENY RIVER

This stream receives a total pollution load of 106,000 sewered population equivalent. Of the five treatment plants, the largest is at Somerset, Pa., and serves 5,400 persons. Laboratory findings show low coliform, biochemical oxygen demand, and pH results while the dissolved oxygen results are fairly high. The largest sources of pollution are at Greensburg, Connellsville, and Somerset, Pa.

Primary treatment should be adequate at Greensburg and at other communities on highly acid streams, pending rather complete acid control. With such control, secondary treatment will be required at Greensburg and at smaller communities located on headwater streams, subject to zero or near-zero flow.

MAIN MONONGAHELA RIVER (EXCEPT PITTSBURGH)

McKeesport, Clairton, Belle Vernon, Charleroi, Morgantown, and Fairmont are the more important cities located on the main stream. None of these places have waste-treatment plants. Industrial wastes are of minor importance except at Clairton and vicinity where there is an industrial waste concentration.

Uniontown, located on Redstone Creek, has primary treatment of domestic sewage for 25,000 persons and for equivalent industrial waste of 2,000. This is the largest treatment plant in the basin. The treatment is adequate at the present time but, should acid in Redstone

Creek be controlled, supplementary secondary treatment facilities would be required.

Jeannette, Pa., on Turtle Creek, has secondary treatment which has been unable to handle all industrial wastes. Pretreatment of these wastes with discharge to the municipal treatment plant is required if full corrective benefits are to be obtained.

Although the laboratory findings indicated generally acceptable conditions at the time of sampling, except for acidity on the main Monongahela River, sewage treatment should be installed to improve conditions at the sewer outfalls, eliminate floating materials, prevent sludge deposits and protect the many waterplants located short distances downstream. Primary treatment should be adequate. Although there has already been considerable activity toward correcting industrial waste pollution in the Clairton area, certain minor additional steps are indicated and continued effort toward reducing this pollution is justified.

CHEAT RIVER

This stream is generally in good sanitary condition and shows little acidity. Recreational use of the stream is important. The largest source of pollution is found at Parsons, W. Va., on the headwaters and is principally due to industrial waste. In view of the present condition of the stream, primary treatment of waste seems justified to remove settleable solids and floating material to prevent local nuisances.

TYGART RIVER

Sanitary conditions are generally good in this stream and acidity is not now a problem, largely because of past mine sealing activities. This stream is used extensively as a source of water supply. Elkins, W. Va., with a sewered population of 8,100 and industrial waste equivalent of 15,000 additional, is the largest source of pollution on this stream. The domestic sewage is untreated but the industrial waste at Elkins is so treated that a reported reduction of 90 percent in settleable solids is obtained and oxygen conditions are generally improved. A high degree of treatment is justified in this area, not only to improve the stream locally but also to protect the waters of Tygart Reservoir.

WEST FORK RIVER

Clarksburg, W. Va., with a sewered population equivalent of 29,000, is by far the largest source of pollution on this stream and its effect is clearly evident in the laboratory findings. The dissolved oxygen is reduced and the biochemical oxygen demand and coliform organisms are increased.

In general, the main stream is not highly acid except near the mouth where many tributary creeks with low pH values discharge acid mine drainage. Two sewage treatment plants are located on this stream.

Secondary treatment of sewage at Clarksburg appears advisable to reduce oxygen demand and coliform counts. At least primary treatment is necessary at all other communities. Weston will require secondary treatment to reduce bacterial pollution.

A summary of costs of the remedial program discussed is shown on table Mo–1.

TABLE Mo–7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
West Fork River above Weston, W. Va.	MoWf 195	June 14, 1940		27.0	7.3	90.2	0.7	15	7.0		36	
Do	do	June 26, 1940	125	19.5	7.7	83.6	.6	93	7.0		38	
Do	do	July 2, 1940	107	18.5	8.1	85.8	.6	39	7.2			
West Fork River, Weston water works.	MoWf 193.5	June 14, 1940		26.0	6.6	80.2	.3	93	6.9		33	
Do	do	June 26, 1940	127	19.5	7.0	75.7	.8	43	6.9		29	
Do	do	July 2, 1940	109	18.5	7.3	77.6	.5	93	7.0			
West Fork River, above Polk Creek	MoWf 183.2	June 17, 1940	119	23.5	6.7	77.6	1.0	2,400	7.0		47	
Do	do	June 26, 1940	130	20.5	7.3	80.0	1.4	2,400	6.9		42	
Do	do	July 2, 1940	110	19.0	7.7	82.4	1.6	430	7.0			
Polk Creek at mouth, Weston, W. Va.	MoWfP 193.5	June 14, 1940		26.5	3.4	42.4	3.7	930	6.9	60	47	47
Do	do	June 26, 1940	8	18.5	5.5	58.5	1.8	1,100	7.0	45	52	46
Do	do	July 2, 1940	19	18.0	7.1	74.5	1.4	2,400	7.0	24		41
Stone Coal Creek at mouth, Weston, W. Va.	MoWfS 194	June 14, 1940		27.0	5.4	66.4	.7	230	6.9	90	44	42
Do	do	June 26, 1940	44	18.5	7.6	81.0	.8	240	7.0	48	44	37
Do	do	July 2, 1940	57	17.5	7.9	81.5	.9	93	7.1	48		41
West Fork River, below Stone Coal Creek, below Weston, W. Va.	MoWf 192	June 14, 1940		26.5	6.0	74.0	1.8	460	6.8		35	
Do	do	June 26, 1940	190	17.5	7.1	73.7	1.2	1,100	7.0	97	50	35
Do	do	July 2, 1940	190	19.0	7.6	81.3	1.1	460	7.1			
West Fork River, below Jackson Mill.	MoWf 189	June 14, 1940		28.0	5.7	71.7	.8	43	7.0	190	43	35
Do	do	June 26, 1940	197	20.0	6.5	71.1	.9	460	6.9		48	
Do	do	July 2, 1940	195	20.0	6.8	74.0	1.3	460	7.0	76		43
West Fork River, below Hackers Creek, Jane Lew, W. Va.	MoWf 180.3	June 17, 1940	220	22.5	6.2	71.3	.9	23	7.0		41	
Do	do	June 27, 1940	210	20.5	7.0	77.6	.5	23	7.1		41	
Do	do	July 3, 1940	359	19.5	7.5	81.3	1.5	240	7.2			
West Fork River, West Milford, W. Va.	MoWf 174	June 17, 1940	244	22.5	7.0	79.4	.9	43	7.0		21	
Do	do	June 27, 1940	224	21.0	7.6	84.2	.8	43	7.1		39	
Do	do	July 3, 1940	415	20.0	7.8	85.2	1.0	43	7.2			
West Fork River, Nutter Fort, W. Va.	MoWf 167	June 17, 1940	268	23.5	7.1	82.2	1.0	43	7.1	47	39	45
Do	do	June 27, 1940	238	20.5	7.4	81.6	.4	9	7.1	76	54	44
Do	do	July 3, 1940	472	20.5	7.9	87.2	.8	93	7.2	72		40

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Brown Creek at mouth, Two Lick, W. Va.	MoWfB 166	June 17, 1940	10	20.5	7.7	84.9	2.5 / [1] 1.2	1	3.0	205	----------	520
Do	do	June 27, 1940	3	17.5	8.2	84.6	1.6 / [1] 0	(2)	2.8	135	----------	660
Do	do	July 3, 1940	7	20.5	8.1	88.9	3.5 / [1] 1.0	2	3.2	110	----------	----------
West Fork River, above Clarksburg, W. Va.	MoWf 161	May 20, 1940	695	20.0	7.2	78.5	[1] .2 / [1] .2	1	6.0	----------	28	----------
Do	do	May 27, 1940	935	18.0	8.0	83.9	3.2	2	6.7	14		----------
Do	do	May 30, 1940	235	18.0	8.2	86.0	.8	2	6.0	16	----------	----------
Do	MoWf 161	June 14, 1940	595	23.0	6.1	70.3	1.0	9	6.6	----------	20	----------
Do	do	June 20, 1940	1,750	21.0	7.0	77.9	1.6	43	6.7	----------	22	----------
Do	do	June 28, 1940	224	22.0	6.4	72.5	----------	9	6.8	----------	18	----------
Do	do	July 2, 1940	575	22.0	7.4	83.8	3.2	24	6.5	----------	28	----------
Do	do	July 10, 1940	43	22.5	6.8	77.7	.4	23	6.6	----------	[1] 24	----------
West Fork River, above mouth Elk Creek, above Clarksburg, W. Va.	MoWf 160	July 10, 1940	----------	23.5	7.4	85.5	.9	460	6.8	----------	25	----------
Elk Creek, above Nutter Fort, W. Va.	MoWfE 167	May 20, 1940	155	18.0	7.2	75.5	.2	24	6.6	----------	42	----------
Do	do	May 27, 1940	215	----------	8.6	----------	.4	21	7.1	----------	10	----------
Do	do	May 30, 1940	50	17.0	6.7	68.8	1.1	9	6.7	----------	38	----------
Do	do	June 14, 1940	135	21.0	7.0	77.9	.7	9	6.8	----------	28	----------
Do	do	June 20, 1940	349	21.0	7.3	81.2	.5	15	6.9	----------	30	----------
Do	do	June 28, 1940	53	22.0	6.9	78.1	----------	2	7.0	----------	35	----------
Do	do	July 2, 1940	268	20.0	7.8	----------	1.0	----------	6.4	----------	28	----------
Do	do	July 10, 1940	15	22.5	7.0	80.0	.3	23	7.3	----------	49	----------
Anmore Creek below Anmore, W. Va.	MoWfA 165	May 28, 1940	9	21.0	9.4	104.6	4.0 / [1] 7.6	240	3.2	----------	----------	----------
Do	do	June 6, 1940	8	24.0	9.0	105.5	3.6 / [1] 2.2	(2)	2.9	----------	----------	----------
Do	do	June 13, 1940	55	23.0	7.4	85.3	1.4 / [1] .8	93	4.5	----------	----------	----------
Do	do	June 19, 1940	16	21.0	5.6	62.3	.6 / [1] 1.6	460	5.7	----------	8	----------
Do	do	June 27, 1940	2	21.0	8.4	93.4	1.2 / [1] 1.6	1	3.1	----------	----------	----------
Do	do	July 1, 1940	12	20.0	8.2	89.4	1.4	----------	6.3	----------	20	----------

Elk Creek West Pike St. Bridge, Clarksburg, W. Va.	MoWfE 159	July 10, 1940	----------	23.0	5.6	63.9	6.0, [1]9.6	730	4.6	----------	7	----------
Elk Creek at mouth, Clarksburg, W. Va.	MoWfE 158	May 20, 1940	174	20.0	5.2	56.7	1.2, [1]2.3	1,100	6.2	----------	20	----------
Do	do	May 27, 1940	235	19.0	8.0	85.6	.6	150	6.5	----------	16	----------
Do	do	May 30, 1940	60	18.0	8.4	88.1	3.2	93	6.0	----------	26	----------
Do	do	June 14, 1940	150	23.0	6.9	79.5	1.3	150	6.8	----------	20	----------
Do	do	June 20, 1940	370	21.0	6.9	76.8	2.5, [1]2.4	(2)	6.7	----------	22	----------
Do	do	June 28, 1940	73	21.0	3.3	36.7	----------	210	5.8	----------	18	----------
Do	do	July 2, 1940	283	----------	7.4	----------	3.7, [1]5.0	230	6.6	----------	24	----------
Do	do	July 10, 1940	24	24.0	1.4	16.4	2.3, [1]2.8	360	5.2	10	12	----------
Limestone Run at mouth, Clarksburg, W. Va.	MoWfL 157	May 28, 1940	13	21.0	9.0	100.1	2.4, [1]4.6	2	4.4	----------	----------	----------
Do	do	June 6, 1940	11	23.0	8.6	99.1	3.8, [1]4.0	9	4.8	----------	----------	----------
Do	do	June 13, 1940	90	24.0	7.8	91.4	2.0, [1]1.8	15	4.7	----------	9	----------
Do	do	June 19, 1940	21	21.0	8.0	89.0	2.2, [1]2.4	240	6.1	----------	18	----------
Do	do	June 27, 1940	5	21.0	8.0	89.0	2.0, [1]2.4	2	4.6	----------	----------	----------
Do	do	July 1, 1940	18	21.0	8.0	89.0	.6, [1]1.6	21	5.6	----------	16	----------
West Fork River, Adamston Bridge, Clarksburg, W. Va.	MoWf 158	May 20, 1940	895	20.0	5.8	63.2	4.7, [1]4.8	4	6.1	----------	34	----------
Do	do	May 27, 1940	1,200	19.0	8.2	87.7	1.2	21	6.7	----------	12	----------
Do	do	May 30, 1940	315	17.0	7.8	80.1	2.4, 1.4	240	6.1	----------	16	----------
Do	do	June 14, 1940	765	24.0	7.4	86.8	5.1	93	6.7	----------	18	----------
Do	do	June 20, 1940	2,100	23.0	7.0	80.6	3.6, [1]3.2	150	6.6	----------	18	----------
Do	do	June 28, 1940	306	22.0	6.4	72.5	----------	2,400	6.7	----------	20	----------
Do	do	July 2, 1940	858	22.0	7.4	83.8	4.9, [1]7.3	240	6.0	----------	24	----------
Do	do	July 10, 1940	----------	24.0	6.2	72.5	2.4	2,300	6.6	----------	19	----------
West Fork River, Perry Mine, below Clarksburg, W. Va.	MoWf 155	May 20, 1940	895	20.0	5.8	63.2	.8, [1]1.0	240	6.3	----------	26	----------
Do	do	May 27, 1940	1,200	19.0	8.0	85.6	4.0	9	6.4	----------	16	----------
Do	do	May 30, 1940	315	17.0	8.0	82.1	2.0, 1.9	460	6.2	----------	18	----------
Do	do	June 14, 1940	765	24.0	6.4	75.0	6.2	240	6.8	----------	19	----------
Do	do	June 20, 1940	2,100	22.0	7.0	79.3	1.2	150	6.7	----------	18	----------
Do	do	June 28, 1940	306	22.0	6.3	71.3	----------	750	6.3	----------	14	----------
Do	do	July 2, 1940	858	22.0	7.4	83.8	2.1	240	6.1	----------	24	----------
Do	do	July 10, 1940	----------	24.0	3.8	44.3	2.6	2,300	6.3	----------	18	----------

[1] Seeded and neutralized.
[2] Less than 1.

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
West Fork River, above Zeising, W. Va.	MoWf 149.8	May 20, 1940	900	21.0	6.2	69.0	2.6 [1]2.0	(2)	5.4		6	
Do	do	May 27, 1940	1,210	19.0	8.0	85.6	.8	21	6.2		16	
Do	do	May 30, 1940	330	18.0	7.4	77.6	2.0	(2)	5.5		14	
Do	do	June 14, 1940	780	23.0	6.6	76.0	3.0	7	6.4		11	
Do	do	June 20, 1940	2,100	22.0	6.8	77.0	.8	30	6.6		18	
Do	do	June 28, 1940	306	22.0	6.1	69.1		24	6.3		6	
Do	do	July 2, 1940	858	21.0	7.4		2.3	240	6.3		20	
Do	do	July 10, 1940	80	25.5	5.8	69.3	1.0 [1]1.1	4	4.1	14		
Simpson Creek, above Bridgeport, W. Va.	MoWfS 162	May 28, 1940	78	17.0	9.2	94.5	4.2 [1]5.0	(2)	2.9			
Do	do	June 6, 1940	65	22.0	9.0	101.9	1.4 [1]1.8		2.8			
Do	do	June 13, 1940	425	20.0	8.5	92.7	3.1 [1]3.1	1	3.2			
Do	do	June 19, 1040	125	20.0	7.7	84.0	1.3 [1]1.2	21	3.2			
Do	do	June 27, 1940	22	18.0	7.8	81.8	.0 [1].8	(2)	2.8			
Do	do	July 1, 1940	384	17.0	7.4	76.0	.2 [1]1.8	110	3.4			
Simpson Creek bridge, below Bridgeport, W. Va.	MoWfS 156	May 28, 1940	83	18.0	9.4	98.5	2.4 [1]3.8	(2)	3.1			
Do	do	June 6, 1940	68	22.0	9.0	101.9	2.0 [1]2.0		2.9			
Do	do	June 13, 1940	450	21.0	7.0	77.9	.2 [1].0	2	3.4			
Do	do	June 19, 1940	125	21.0	7.6	84.5	.6 [1]1.3	24	3.5			
Do	do	June 27, 1940	22	19.0	8.4	89.8	.2 [1].8	1	2.9			
Do	do	July 1, 1940	384	17.0	7.2	73.9	.0 [1].2	110	3.4			

Salem Fork, East Salem, W. Va.	MoWfTSa 168.5	May 28, 1940	11	20.0	2.6	28.4	9.6	210	7.1	----------	130	----------
Do.	do.	June 6, 1940	9	24.0	3.0	35.2	10.4	430	6.8	----------	----------	----------
Do.	do.	June 13, 1940	70	25.0	----------	----------	7.6 / [1] 8.8	150	6.8	----------	62	----------
Do.	do.	June 19, 1940	18	21.0	5.8	64.5	3.5 / [1] 3.6	----------	6.9	----------	32	----------
Do.	do.	June 27, 1940	----------	21.0	----------	----------	4.4 / [1] 3.2	93	7.0	----------	72	----------
Do.	do.	July 1, 1940	10	19.0	6.4	68.4	4.8	930	6.4	----------	24	----------
Salem Fork, below East Salem, W. Va.	MoWfTSa 167.5	May 28, 1940	12	17.0	7.8	80.1	3.8 / [1] 7.2	210	7.0	----------	124	----------
Do.	do.	June 6, 1940	10	24.0	4.8	56.3	2.2 / [1] 2.4	29	6.6	----------	42	----------
Do.	do.	June 13, 1940	74	25.0	2.0	23.9	4.8 / [1] 4.8	24	6.9	----------	62	----------
Do.	do.	June 19, 1940	18	21.0	6.0	66.7	3.6 / [1] 3.2	240	6.7	----------	26	----------
Do.	do.	June 27, 1940	----------	21.0	4.2	46.7	1.2 / [1] 2.4	360	7.0	----------	62	----------
Do.	do.	July 1, 1940	10	19.0	6.6	70.6	2.6	1,100	6.4	----------	28	----------
Ten Mile Creek, above Lumberport, Laura Lee, W. Va.	MoWfT 148	May 29, 1940	560	18.0	8.6	90.1	.2	4	5.8	----------	9	----------
Do.	do.	June 7, 1940	43	19.0	7.2	77.0	.2 / [1] .4	1	6.0	----------	8	----------
Do.	do.	June 18, 1940	581	23.0	7.0	80.6	----------	9	6.1	----------	12	----------
Ten Mile Creek, above Lumberport, above Laura Lee, W. Va.	MoWfT 148	June 21, 1940	92	19.0	7.8	83.4	1.2	24	6.6	----------	21	----------
Do.	do.	June 29, 2940	61	22.0	7.2	81.5	1.2	460	6.2	----------	16	----------
Do.	do.	July 3, 1940	116	17.0	8.2	84.2	.8	93	6.1	----------	30	----------
Ten Mile Creek, at mouth, below Lumberport, W. Va.	MoWfT 146.5	May 29, 1940	570	18.0	9.2	96.4	1.0 / [1] 2.0	(2)	4.6	----------	9	----------
Do.	do.	June 7, 1940	47	24.0	7.0	82.1	2.6 / [1] 2.8	(2)	4.8	----------	----------	----------
Do.	do.	June 18, 1940	581	22.0	6.2	70.2	4.0 / [1] 4.2	3	6.3	----------	5	----------
Do.	do.	June 21, 1940	92	19.0	7.8	83.4	1.3 / [1] .9	24	6.5	----------	18	----------
Do.	do.	June 29, 1940	61	21.0	7.1	79.0	.9	93	6.1	----------	14	----------
Do.	do.	July 3, 1940	117	22.0	7.8	88.3	.1	24	5.6	----------	20	----------
West Fork River Bridge, below Ten Mile Creek, below Lumberport, W. Va.	MoWf 145.5	June 7, 1940	----------	23.0	5.4	62.2	.2 / [1] .2	(2)	3.2	----------	----------	----------
Do.	do.	June 18, 1940	610	23.0	6.9	79.5	.9 / [1] 1.9	150	3.4	----------	----------	----------
Do.	do.	June 21, 1940	1,430	20.0	7.1	77.4	1.5 / [1] 1.2	43	4.7	----------	----------	----------
Do.	do.	June 29, 1940	525	22.0	7.4	83.8	.4 / [1] .2	24	3.3	----------	----------	----------
Do.	do.	July 3, 1940	4,370	18.0	7.2	75.5	.6 / [1] 1.8	240	4.4	----------	----------	----------

[1] Seeded and neutralized.
[2] Less than 1.

TABLE MO-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
West Fork River, below Shinnston, W. Va.	MoWf 143.5	May 29, 1940	700	19.0	8.8	94.1		9	3.5			
Do	do	June 7, 1940	370	25.0	6.2	74.0	.6 [1] .2	(2)	3.2			
Do	do	June 18, 1940	710	23.0	6.4	73.7	.9 [1] 1.3	93	3.4			
Do	do	June 21, 1940	1,320	20.0	7.4	80.7	.9 [1] .8	43	4.8			
Do	do	June 29, 1940	525	22.0	7.2	81.5	0 [1] 1.2	43	3.4			
Do	do	July 3, 1940	4,370	19.0	7.4	79.1	1.6 [1] 3.3		4.6			
West Fork River Bridge, above Worthington, W. Va.	MoWf 138	May 21, 1940	4,950	19.0	7.6	81.3	1.2 [1] 1.0	6	5.7			
Do	do	June 12, 1940	780	27.0	7.6	94.2	1.4 [1] 1.4	9	3.5			
Do	do	June 26, 1940	755		7.6		1.2 [1] .6	93	3.8			
West Fork River, Highway Bridge below Monongah, W. Va.	MoWf 132.5	May 21, 1940	5,130	19.0	7.4	79.1	2.0 [1] 1.8	43	6.0		12	
Do	do	May 24, 1940	600	20.0	7.2	78.5	.8 [1] 1.0	24	3.6		14	
Do	do	June 4, 1940	1,250	19.0	7.6	81.3		2	3.3			
Do	do	June 12, 1940	800	27.0	6.6	81.8	.2 [1] .2	24	3.5			
Do	do	June 26, 1940	759		7.3		.1 [1] .1	24	3.8			
West Fork River, at mouth, Fairmont, W. Va.	MoWf 129	May 21, 1940	5,250	19.0	7.2	77.0	.4 [1] .8	5	5.4		10	
Do	do	May 24, 1940	640	21.0	5.2	57.8	.4 [1] .8	2	4.4		2	
Do	do	June 4, 1940	1,300	19.0	8.0	85.6		2	4.3			
Do	do	June 12, 1940	850	28.0	5.8	73.2	.0 [1] 1.4	2	3.6			
Do	do	June 26, 1940	788		6.9		.3 [1] .0	23	3.9			
Tygart River water plant intake, above Elkins, W. Va.	MoTy 211	June 13, 1940		18.5	7.9	83.7	.9	1,100	6.9		30	
Do	do	June 21, 1940	770	16.5	8.4	85.1	.8	23	7.0		39	
Do	do	July 1, 1940	388	19.0	8.1	86.5	.7	43	7.2			
Do	do	July 9, 1940	196	21.0	8.4	93.0	.9	750	7.3			

Tygart River, 4 miles below Elkins, W. Va.	MoTy 205.5	June 13, 1940		22.0	7.2	81.9	2.0	2,400	6.8		28	
Do	do	June 21, 1940	790	16.0	8.2	82.4	1.0	210	6.9		31	
Do	do	July 1, 1940	410	17.5	7.5	78.2	1.7	460	6.9			
Do	do	July 9, 1940	215	20.0	6.2	67.5	1.6	230	6.9			
Grassy Run, at mouth, Norton, W. Va.	MoTyG 202	do	1	16.0	8.2	82.6	[1] 2.0	([2])	2.5	5		
Tygart River, 7 miles below Elkins, W. Va.	MoTy 201.5	do	226	20.0	7.0	76.8	1.6	150	7.1			
Tygart River, 8 miles below Elkins, Norton, W. Va.	MoTy 201.3	June 13, 1940		22.0	7.5	85.3	.7	2,400	6.9		27	
Do	do	June 21, 1940	950	16.0	8.5	85.3	.9	930	7.0		30	
Do	do	July 1, 1940	490	18.0	7.8	81.8	.6	110	7.1			
Do	do	July 9, 1940	238	21.5	7.2	80.8	.7		7.2	13		43
Tygart River bridge, lower edge of Belington, W. Va.	MoTy 192	June 13, 1940		23.5	8.0	93.6	.9	1,100	6.9	200	32	30
Do	do	June 21, 1940	1,100	14.5	9.0	87.5	.5	240	6.8	18	25	30
Do	do	July 1, 1940	592	17.0	8.4	86.3	.7	230	6.8	22		39
Middle Fork River, Burnt Bridge, W. Va.	MoTyMf 198	June 13, 1940		23.5	8.2	95.7	.2	3	6.8	7	18	15
Do	do	June 21, 1940	250	13.5	9.5	90.3	.4	46	6.7	8	13	12
Do	do	July 1, 1940	210	16.5	8.8	88.9	.4	7	6.7	6		12
Buckhannon River, above Buckhannon, W. Va.	MoTyBu 206	June 13, 1940		24.0	7.4	87.0	.2	46	6.7		17	
Do	do	June 21, 1940	350	15.5	8.8	87.6	.7	43	6.7		19	
Do	do	July 1, 1940	240	17.0	8.5	87.1	.4	93	6.7			
Buckhannon River, below Buckhannon, W. Va.	MoTyBu 201.5	June 13, 1940		25.5	7.0	84.0	.4	150	6.7	35	24	20
Do	do	June 21, 1940	550	16.0	8.4	84.5	.5	43	6.7	13	23	24
Do	do	July 1, 1940	460	18.0	8.0	84.2	1.0	93	6.7	28		20
Buckhannon River, Carrollton, W. Va.	MoTyBu 180	June 12, 1940		25.5	7.2	87.0	1.7	210	6.6	500	23	22
Do	do	June 20, 1940	1,450	19.0	8.3	89.2	1.3	240	6.6	24	21	19
Do	do	June 28, 1940	366	21.0	8.3	92.2	1.0	9	6.8	23		21
Tygart River, above Philippi, W. Va.	MoTy 174.5	June 12, 1940		27.0	7.7	95.5	1.7	150	6.8		42	
Do	do	June 20, 1940	4,500	18.0	8.8	91.7	.9	460	6.7		23	
Do	do	June 28, 1940	980	20.5	8.2	90.0	.6	4	6.6			
Tygart River, Arden, W. Va.	MoTy 166.5	June 12, 1940		27.0	7.6	94.5	.5	23	6.9		28	
Do	do	June 20, 1940	8,000	17.5	8.7	89.8	1.4	93	6.8		27	
Do	do	June 28, 1940	1,000	21.5	8.2	92.0	.4	4	6.8			
Tygart River, steel bridge above Grafton, W. Va.	MoTy 150	June 12, 1940		21.5	10.2	114.1	.3	2	6.6		18	
Do	do	June 20, 1940	8,400	17.0	10.3	105.7	.7	4	6.6		18	
Do	do	June 28, 1940	1,550	20.0	9.5	103.7	.4	23	6.8			
Three Forks Creek, ½ mile above mouth, Grafton, W. Va.	MoTyTf 149.5	June 12, 1940		26.0	8.1	98.4	.5 [1] .7	43	5.6	2	16	52
Do	do	June 20, 1940	432	16.0	9.3	93.7	.5	240	6.6	23	20	35
Do	do	June 28, 1940	70	21.5	8.2	92.6	1.8 [1] 1.5	43	5.8	8		57

[1] Seeded and neueralized.
[2] Less than 1.

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Tygart River bridge on Route 50, below Grafton, W. Va.	MoTy 146.7	June 12, 1940	----------	21.0	9.5	105.6	.4	23	6.7	----------	15	----------
Do	do	June 20, 1940	8,800	17.0	10.1	103.3	.7	43	6.6	----------	16	----------
Do	do	June 28, 1940	1,620	20.5	9.3	102.4	.6	23	6.8	----------		----------
Tygart River, 3 miles above mouth, Benton Ferry, W. Va.	MoTy 132	June 12, 1940	----------	22.5	8.9	101.3	.4	23	6.6	14	17	30
Do	do	June 20, 1940	8,800	16.5	9.7	98.6	.6	23	6.6	27	19	26
Do	do	June 28, 1940	1,630	20.5	8.4	92.8	.6	23	6.8	20	----------	27
Monongahela River highway bridge Fairmont, W. Va.	Mo 126.7	May 21, 1940	6,520	18.0	7.6	79.7	.0 1.2	(2)	5.0	----------	10	----------
Do	do	May 24, 1940	2,420	18.0	8.8	92.2	2.6 2.4	3	4.4	----------	4	----------
Do	do	June 4, 1940	7,540	19.0	8.2	87.7	----------	93	5.4	----------	12	----------
Do	do	June 12, 1940	2,400	27.0	6.4	79.3	----------	1	3.9	----------	----------	----------
Do	do	June 26, 1940	2,420	----------	7.4	----------	1.4 1.8	21	4.5	----------	4	----------
Buffalo Creek bridge above Mannington, W. Va.	MoBc 145	May 29, 1940	30	19.0	6.8	72.7	----------	150	6.6	----------	32	----------
Do	do	June 7, 1940	22	25.0	7.2	85.9	.4 1.8	24	7.0	----------	20	----------
Do	do	June 18, 1940	32	22.0	6.6	74.7	.9	93	6.3	----------	28	----------
Do	do	June 21, 1940	21	18.0	7.8	81.8	.8	15	6.9	----------	24	----------
Do	do	June 29, 1940	32	23.0	6.3	72.6	1.3	93	6.9	----------	26	----------
Do	do	July 3, 1940	33	19.0	8.0	85.6	2.4	43	5.9	----------	26	----------
Buffalo Creek foot bridge, below Mannington, W. Va.	MoBc 140.7	May 29, 1940	115	20.0	7.4	80.7	----------	200	6.4	----------	32	----------
Do	do	June 7, 1940	45	25.0	5.2	62.1	2.6 [1] 2.8	(2)	7.0	----------	26	----------
Do	do	June 18, 1940	118	23.0	6.3	72.6	1.9 [1] 2.0	930	6.3	----------	28	----------
Do	do	June 21, 1940	75	18.0	7.8	81.8	.8 1.8	210	6.9	----------	26	----------
Do	do	June 29, 1940	62	22.0	6.0	68.0	3.2 [1] 1.0	750	6.8	----------	28	----------
Do	do	July 3, 1940	94	18.0	8.0	83.9	1.0	240	5.8	----------	26	----------

Buffalo Creek railroad bridge, at mouth, Fairmont, W. Va.	MoBc 127	May 21, 1940	575	18.0	7.8	81.8	1.6 / [1] 1.3	1	5.4	----------	12	----------
Do	do	May 24, 1940	70	21.0	7.2	80.1	2.2 / [1] 2.4	110	6.2	----------	12	----------
Do	do	June 4, 1940	150	20.0	8.0	87.2	----------	43	5.2	----------	10	----------
Do	do	June 12, 1940	98	26.0	7.2	87.6	2.8 / [1] 4.0	4	7.0	----------	48	----------
Do	do	June 26, 1940	76	----------	7.6	----------	2.8 / [1] .8	75	6.9	----------	64	----------
Monongahela River railroad bridge, below Fairmont, W. Va.	Mo 124.2	May 21, 1940	7,100	19.0	8.2	87.7	1.0 / [1] 1.2	(2)	----------	----------	10	----------
Do	do	May 24, 1940	2,500	18.0	8.6	90.1	1.6 / [1] 1.6	2	6.6	----------	8	----------
Monongahela River railroad bridge, below Fairmont, W. Va.	Mo 124.2	June 4, 1940	7,700	19.0	8.4	89.8	----------	9	5.2	----------	12	----------
Do	do	June 12, 1940	2,500	27.0	6.6	81.8	1.2 / [1] .4	1	3.9	----------	----------	----------
Do	do	June 26, 1940	2,500	----------	7.4	----------	.6 / [1] .2	93	4.5	----------	4	----------
Monongahela River, lock No. 11, above Morgantown, W. Va.	Mo 104.1	May 16, 1940	1,030	16.0	8.8	88.4	----------	(2)	3.5	----------	50	----------
Do	do	May 23, 1940	3,200	20.0	8.6	93.8	1.4 / [1] 1.8	(2)	4.5	----------	8	----------
Do	do	June 3, 1940	11,300	19.0	8.2	87.7	.4 / [1] .6	(2)	5.2	----------	4	----------
Do	do	June 11, 1940	3,000	26.0	7.8	94.9	.4 / [1] .6	1	4.0	----------	----------	----------
Do	do	June 17, 1940	3,000	23.0	8.0	92.2	2.0 / [1] .9	2	4.9	----------	----------	----------
Do	do	June 25, 1940	9,350	----------	8.1	----------	.5 / [1] .9	4	5.1	----------	6	----------
Deckers Creek Bridge, above Sabraton, W. Va.	MoDe 104	June 3, 1940	50	15.0	9.6	94.6	1.4 / [1] 1.8	(2)	5.4	----------	4	----------
Do	do	June 11, 1940	15	25.0	7.6	90.7	1.6 / [1] 2.0	2	4.5	----------	----------	----------
Do	do	June 17, 1940	45	23.0	7.6	87.6	1.4 / [1] .6	2	3.9	----------	----------	----------
Do	do	June 25, 1940	49	----------	7.9	----------	.2 / [1] .1	1	4.6	----------	----------	----------
Deckers Creek, shirt factory bridge, above Morgantown, W. Va.	MoDe 103	May 16, 1940	10	16.0	8.8	88.4	----------	43	4.1	----------	6	----------
Do	do	May 23, 1940	20	19.0	9.0	96.3	2.0	1	5.1	----------	6	----------
Do	do	June 3, 1940	55	15.0	9.4	92.6	.6 / [1] 1.2	1	5.2	----------	4	----------
Do	do	June 11, 1940	20	25.0	7.4	88.3	1.6 / [1] 2.0	15	4.5	----------	----------	----------
Do	do	June 17, 1940	30	23.0	7.8	89.9	2.0 / [1] .9	24	3.9	----------	----------	----------
Do	do	June 25, 1940	54	----------	8.0	----------	.6 / [1] 1.7	9	4.6	----------	2	----------

[1] Seeded and neutralized.
[2] Less than 1

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Deckers Creek railroad bridge, at mouth, Morgantown, W. Va.	MoDe 101	May 16, 1940	15	16.0	8.0	80.4		110	4.5			
Do	do	May 23, 1940	25	20.0	8.0	87.2	1.4 [1]2.0	150	4.9		6	
Do	do	June 3, 1940	60	16.0	9.4	94.5	3.4 [1]3.0	7	5.2		6	
Do	do	June 11, 1940	25	25.0	7.4	88.3	4.0 [1]3.8	24	4.6			
Do	do	June 17, 1940	35	23.0	6.8	78.3	6.0 [1]2.6	15	4.5			
Do	do	June 25, 1940	54		7.8		2.6 [1]4.0	930	5.3		5	
Monongahela River, river bridge, Morgantown, W. Va.	Mo 100.9	May 16, 1940	1,050	16.0	8.0	80.4		(3)	3.5		34	
Do	do	May 23, 1940	3,250	20.0	8.8	96.0	1.4 [1]2.0	1	4.4		6	
Do	do	June 3, 1940	11,400	19.0	8.2	87.7	2.0 [1]1.8	4	5.0		6	
Do	do	June 11, 1940	3,050	25.5	7.8	94.0	1.0 [1]1.6	4	4.4			
Do	do	June 17, 1940	3,000	23.0	7.4	85.3	.6 [1].6	4	4.8			
Do	do	June 25, 1940	9,400		8.0		1.2 [1].8	9	5.4		6	
Monongahela River, river ferry, Star City, W. Va.	Mo 97.7	May 16, 1940	1,070	17.0	8.8	90.3		(3)	3.5		36	
Do	do	May 23, 1940	3,300	20.0	8.2	89.4	1.4 [1]1.0	1	5.2		4	
Do	do	June 3, 1940	11,400	19.0	8.8	94.1	.2 [1].0	2	4.3			
Do	do	June 11, 1940	3,050	26.0	7.8	94.9	.2 [1].2	2	4.2			
Do	do	June 17, 1940	3,000	23.0	7.8	89.9	.1 [1]0	2	4.4			
Do	do	June 25, 1940	9,450		7.6		.3 [1].5	93	4.6		2	

Monongahela River, dam No. 8, Point Marion, Pa.	Mo 90	May 31, 1940	38,000	16.0	9.6	96.5	.8	8	5.0		8	
Do	do	June 10, 1940	3,250	21.0	7.6	84.5	.8 [1] 1.0	8	3.9		15	
Do	do	June 22, 1940	6,790	19.0	8.2	87.7	0 [1] .4	24	5.1		4	
Do	do	Aug. 19, 1940	450	26.5	7.3	90.0	[1] .5 .5	(2)	3.3			
Do	do	Aug. 27, 1940	450	23.5	8.2	94.9	.7 [1] .4	(2)	3.2			
Do	do	Sept. 4, 1940	1,010	23.5	7.8	91.3	1.1 [1] .6	(2)	3.5			
Do	do	Sept. 13, 1940	845	21.0	8.4	93.1	1.3 [1] .9	(2)	3.2			
Do	do	Sept. 17, 1940	845	20.5	8.4	92.6	1.1 [1] .8	(2)	3.4			
Do	do	Sept. 24, 1940	340	21.5	7.8	87.0	1.1 [1] .9	(2)	3.5			
Do	do	Oct. 2, 1940	1,770	17.0	9.2	94.5	.6 [1] .6	4	4.3			
Do	do	Oct. 8, 1940	1,370	17.5	9.1	94.1	.8 [1] .7	1	3.8			
Do	do	Oct. 17, 1940	630	16.0	9.2	92.3	1.0 [1] .8	(2)	3.5			
Do	do	Oct. 22, 1940	630	13.0	9.7	91.5	1.2 [1] .9	(2)	3.5			
Do	do	Oct. 30, 1940	1,050	13.5	10.0	95.1	2.4 [1] 1.8	(2)	3.7			
Do	do	Nov. 4, 1940	4,140	12.5	11.1	103.3	1.1 [1] 1.1		4.6			
Do	do	Nov. 12, 1940	1,830	11.5	10.8	98.8	.9 [1] .4	(2)	4.1			
Do	do	Nov. 20, 1940	2,110	7.5	11.5	95.9	1.2 [1] 1.7	(2)	4.3			
Do	do	Nov. 26, 1940	4,190	7.5	12.2	101.9	.6 [1] .9	2	4.2			
Do	do	Dec. 5, 1940	4,000	4.0	13.1	99.9	.6 [1] .4	1	4.1			
Do	do	Dec. 9, 1940	4,500	4.0	12.7	96.4	.8 [1] .5	(2)	4.1			
Shaver Fork, 3½ miles above Parsons, Porterwood, W. Va.	MoChS 168	June 19, 1940	2,800	15.5	8.6	86.0	1.2	9	6.6	27	22	23
Do	do	June 25, 1940	430	18.5	8.5	89.9	.3	15	6.9	4	31	25
Do	do	July 5, 1940	380	16.5	8.9	90.4	.5	4	6.8	3		24
Blackwater River, above falls in State park, Davis, W. Va.	MoChDfBl-180	June 19, 1940	600	18.0	7.8	81.2	1.6	150	6.5		22	
Do	do	June 25, 1940	135	16.5	8.4	85.8	.9	120	6.9		30	
Do	do	July 5, 1940	325	15.0	8.6	84.8	1.9	43	6.7			

[1] Seeded and neutralized.

[2] Less than 1.

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
North Fork, Blackwater River bridge, above Thomas, W. Va.	MoChNBl 182	June 19, 1940	64	17.0	6.7	68.6	.7 [1].9	43	5.6	----------	17	----------
Do	do	June 25, 1940	29	16.5	7.6	77.0	.2 [1].4	4	5.5	----------	20	----------
Do	do	July 5, 1940	37	14.5	7.5	72.9	.5 [1].4	23	5.5	----------	----------	----------
North Fork, Blackwater River bridge, below Thomas, W. Va.	MoChNbL-1805	June 19, 1940	64	17.5	8.1	84.0	1.3	93	6.3	23	25	44
Do	do	June 25, 1940	29	18.0	8.0	83.9	.5 [1].7	9	4.7	20	26	80
Do	do	July 5, 1940	38	15.5	8.5	84.6	.5 [1].6	4	5.	25	----------	----------
Blackwater River bridge, at mouth, Hendrick, W. Va.	MoChDfBl-172	July 19, 1940	1,000	18.5	8.3	88.2	1.2 [1]1.2	46	5.3	35	18	26
Do	do	July 25, 1940	250	16.5	8.7	88.6	.5 [1].6	43	4.4	34	21	39
Do	do	July 5, 1940	520	14.0	9.2	88.4	.8 [1].7	9	4.6	28	----------	----------
Dry Fork River, Hendrick, W. Va.	MoChDf 172	June 19, 1940	1,800	16.5	9.0	91.0	.7	23	7.2	----------	37	----------
Do	do	June 25, 1940	530	17.5	8.8	91.7	.4	23	7.3	----------	33	----------
Do	do	July 5, 1940	530	15.0	9.3	91.6	.4	9	6.9	----------	----------	----------
Dry Fork River bridge, above Parsons, W. Va.	MoChDf 168	June 19, 1940	2,800	18.5	8.7	91.9	1.1	23	6.9	25	28	34
Do	do	June 25, 1940	780	16.5	7.6	87.1	.4	23	6.6	22	30	30
Do	do	July 5, 1940	1,100	14.5	9.1	89.0	.5	9	6.6	15	----------	30
Cheat River, 2 miles below Parsons, Holly Meadows, W. Va.	MoCh 165.5	June 19, 1940	5,600	17.5	8.7	89.9	.8	23	6.9	28	28	29
Do	do	June 25, 1940	1,380	17.5	8.4	86.7	.3	15	6.8	16	33	27
Do	do	July 5, 1940	1,700	15.0	8.9	88.6	.3	23	6.7	14	----------	26
Cheat River, 5 miles below Parsons, St. George, W. Va.	MoCh 158	June 18, 1940	4,000	20.5	8.1	88.9	.5	39	6.9	22	26	45
Do	do	June 24, 1940	1,500	21.0	8.1	89.7	.6	9	6.9	17	23	33
Do	do	July 8, 1940	990	18.0	8.6	90.1	.4	46	6.9	13	----------	30
Cheat River, foot bridge below Rowlesburg, W. Va.	MoCh 133	June 18, 1940	4,300	22.0	8.1	91.4	.7	120	6.9	----------	24	----------
Do	do	June 24, 1940	1,550	23.0	8.2	94.9	.3	23	6.9	----------	28	----------
Do	do	July 8, 1940	1,250	21.0	8.7	96.9	.8	23	6.8	----------	----------	----------
Cheat River, 1 mile east of Kingwood, Caddell, W. Va.	MoCh 120.5	June 18, 1940	4,600	21.0	8.3	92.7	.6	23	6.8	----------	22	----------
Do	do	June 24, 1940	1,600	20.5	8.3	91.6	.3	9	6.9	----------	29	----------
Do	do	July 8, 1940	1,120	20.0	8.7	94.9	.3	4	6.8	----------	----------	----------

Green Run Creek, between Kingwood and Allbright, W. Va.	MoChGr 118.5	June 18, 1940	19	20.0	8.4	91.6	.8 [1].4	110	3.6	30	----------	44
Do	do	June 24, 1940	8	19.5	8.3	90.1	.4 [1].1	4	3.5	13	----------	47
Do	do	July 8, 1940	5	17.5	9.0	93.6	.7 [1].3	(2)	3.3	13	----------	----------
Cheat Lake bridge at Ices Ferry	MoCh 100.5	May 31, 1940	32,000	13.0	10.2	96.2	1.6	15	6.5	----------	8	----------
Do	do	June 10, 1940	2,400	21.0	7.4	82.3	1.6 [1]2.0	75	6.1	----------	10	----------
Do	do	June 22, 1940	1,220	20.0	7.4	80.7	.4	21	6.5	----------	8	----------
Cheat River bridge, at mouth, Point Marion, Pa.	MoCh 90	May 31, 1940	35,300	16.0	9.8	98.5	.8	1	6.4	----------	10	----------
Do	do	June 10, 1940	3,730	21.0	8.6	95.7	1.0 [1]1.0	9	3.9	----------	----------	----------
Do	do	June 22, 1940	1,220	21.0	7.4	82.3	.6	24	6.1	----------	8	----------
Monongahela River lock and dam No. 7, Greensboro, Pa.	Mo 84.8	May 31, 1940	61,900	15.0	9.2	90.6	.8	9	5.7	----------	8	----------
Do	do	June 10, 1940	4,060	21.0	7.4	82.3	1.4 [1]1.4	24	3.9	----------	----------	----------
Do	do	June 22, 1940	9,230	18.0	8.4	88.1	.5 [1].6	24	5.3	----------	7	----------
Do	do	Aug. 19, 1940	640	26.0	7.5	91.5	[1].6 .7	(2)	3.4	----------	----------	----------
Do	do	Aug. 27, 1940	1,020	22.0	8.6	97.1	[1].6 1.2	(2)	3.2	----------	----------	----------
Do	do	Sept. 4, 1940	1,480	22.5	8.3	94.7	.6 [1].9	(2)	3.8	----------	----------	----------
Do	do	Sept. 13, 1940	1,020	20.5	8.0	87.6	1.0 [1].8	(2)	3.6	----------	----------	----------
Do	do	Sept. 17, 1940	1,020	20.5	8.3	91.4	1.5 [1]1.0	(2)	3.3	----------	----------	----------
Do	do	Sept. 24, 1940	830	21.5	8.2	92.1	[1].5 1.0	(2)	3.5	----------	----------	----------
Do	do	Oct. 2, 9940	1,940	16.5	9.7	98.2	.5 [1].6	2	4.3	----------	----------	----------
Do	do	Oct. 8, 1940	1,480	17.0	9.1	93.8	.7 [1].7	2	3.8	----------	----------	----------
Do	do	Oct. 17, 1940	1,240	15.5	9.3	92.7	1.0 [1].8	(2)	3.7	----------	----------	----------
Do	do	Oct. 22, 1940	1,240	13.0	10.1	95.0	1.4 [1].9	(2)	3.7	----------	----------	----------
Do	do	Oct. 30, 1940	1,480	13.0	10.3	96.9	2.6 [1]1.4	(2)	3.7	----------	----------	----------
Do	do	Nov. 4, 1940	5,740	12.0	10.8	99.7	1.4 [1]1.6	4	4.7	----------	----------	----------
Do	do	Nov. 12, 1940	2,020	11.0	11.2	101.1	.8	(2)	6.5	----------	3	----------
Do	do	Nov. 20, 1940	2,630	7.5	12.0	99.8	.7	(2)	6.1	----------	4	----------
Do	do	Nov. 26, 1940	5,740	6.5	12.2	99.4	.8 [1].8	1	4.4	----------	----------	----------

[1] Seeded and neutralized.

[2] Less tnan 1.

TABLE Mo–7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Monongahela River, lock and dam No. 7, Greensboro, Pa.	Mo 84.8	Dec. 5, 1940	4,060	4.0	13.2	100.6	.5 [1] .4	2	4.2			
Do	do	Dec. 9, 1940	5,300	4.0	12.8	97.3	.6 [1] .6	3	4.1			
Muddy Creek, upper edge of Fairchance, W. Va.	MoGeMu 96	Aug. 22, 1940	(2)	18.0	8.8	92.5	.3	23	7.1		20	
Do	do	Oct. 10, 1940	(2)	10.0	10.7	94.4	1.2	110	6.9		24	
Do	do	Nov. 15, 1940	1	5.0	11.7	91.6	.8	75	6.3		16	
Muddy Creek, below Fairchance, W. Va.	MoGeMu 95	Aug. 22, 1940	1	18.5	8.9	94.5	.5 [1] .6	4	3.9	3		124
Do	do	Oct. 10, 1940	1	9.5	10.2	89.2	.9 [1] .9	(2)	5.3		4	164
Do	do	Nov. 15, 1940	6	4.0	11.6	88.0	.6 [1] .8	46	5.3	6		93
Georges Creek, below mouth of Muddy Run.	MoGe 94.6	Aug. 22, 1940	(2)	17.0	8.8	90.9	1.7	23	7.2	3	34	42
Do	do	Oct. 10, 1940	1	9.0	9.6	83.1	3.4	240	7.1	5	36	74
Do	do	Nov. 15, 1940	4	4.5	10.9	84.2	2.3	2,400	6.3	4	23	61
Georges Creek, ½ mile below Smithfield, Pa.	MoGe 91.5	Aug. 23, 1940	1	18.0	7.0	73.1	.6 [1] .4	1	3.6	3		144
Do	do	Oct. 11, 1940	1	9.0	9.1	78.1	1.4 [1] .8	1	4.2	7		267
Do	do	Dec. 3, 1940	10	0	12.9	83.3	.8 [1] .9	4	5.6	10		89
Jacobs Creek, Greensboro, Pa	MoJa 84	Oct. 2, 1940	2	12.0	9.5	87.5	3.3 [1] 2.4	46	6.9	500	22	562
Do	do	Oct. 8, 1940	2	14.0	8.9	85.5	.5 [1] .8	9	4.2	9		429
Cats Creek, upper edge of Masontown, Pa.	MoCa 83	Aug. 23, 1940	(2)	16.5	6.8	69.5	1.6	93	7.1		42	
Do	do	Oct. 11, 1940	(2)	8.5	8.7	73.9	2.7	240	7.1	180	46	63
Do	do	Dec. 3, 1940	(2)	0	12.5	85.2	1.8	43	7.0		26	
Cats Creek ½ mile below Masontown, Pa.	MoCa 81	Aug. 23, 1940	1	18.0	8.0	83.4	6.7 [1] 1.6	(2)	2.5	17		1,420
Do	do	Oct. 11, 1940	1	10.5	10.8	96.3	[1] .2 14.2	(2)	2.5			
Do	do	Dec. 3, 1940	1	0	14.7	100.6	5.8 [1] 3.5	36	2.9	47		1,360

Big Run at mouth, Masontown, Pa.	MoBi 78.5	Aug. 23, 1940	([2])	16.5	3.0	30.6	15.3	1,100	7.5	258	184	
Do	do	Oct. 11, 1940	([2])	9.5	5.1	44.5	24.2	4,600	7.6	10	251	165
Do	do	Dec. 3, 1940	1	1.0	10.9	76.8	3.6	930	7.6	5	181	203
Monongahela River dam No. 6, Rice Landing, Pa.	Mo 68.3	Aug. 19, 1940	670	26.5	7.2	88.2	[1] 1.4 .3	([2])	3.3			
Do	do	Aug. 27, 1940	1,280	22.5	7.7	88.3	[1] 1.3 .7	4	3.2			
Do	do	Sept. 4, 1940	2,610	22.5	7.9	90.4	.8 [1] 1.6	([2])	3.8			
Do	do	Sept. 13, 1940	1,490	20.5	8.0	88.1	1.0 [1] 1.6	([2])	3.3			
Do	do	Sept. 17, 1940	1,300	20.0	8.2	90.0	[1] 1.2 1.1	([2])	3.4			
Do	do	Sept. 24, 1940	860	21.5	8.0	90.3	[1] 1.5 .5	([2])	3.3			
Do	do	Oct. 2, 1940	2,340	16.5	8.7	88.6	[1] 1.5 1.1	([2])	3.5			
Do	do	Oct. 8, 1940	1,800	17.0	8.7	89.5	[1] 1.7 .6	1	3.8			
Do	do	Oct. 17, 1940	1,200	15.0	9.2	90.4	[1] 1.7 .9	([2])	3.6			
Do	do	Oct. 22, 1940	1,380	12.5	9.8	91.9	[1] 1.9 1.2	([2])	3.6			
Do	do	Oct. 30, 1940	1,740	13.0	9.9	93.1	[1] 1.4 2.6	9	3.6			
Do	do	Nov. 4, 1940	7,560	13.0	9.9	93.8	1.1 [1] 1.2	([2])	4.5			
Do	do	Nov. 12, 1940	2,400	10.5	10.7	95.1	1.0	([2])	6.5		7	
Do	do	Nov. 20, 1940	3,240	7.0	11.4	93.6	.8 [1] 1.2	([2])	4.2			
Do	do	Nov. 26, 1940	8,610	7.0	11.7	96.4	.8 [1] 1.0	([2])	4.2			
Do	do	Dec. 5, 1940	5,140	4.0	12.6	96.0	.7 [1] .5	([2])	5.5			
Do	do	Dec. 9, 1940	5,530	4.0	12.5	95.0	.8 [1] .6	1	4.3			
South Fork Ten Mile Creek, upper edge of town, Waynesburg, Pa.	MoTeSf 85.5	Aug. 21, 1940	2	20.5	6.0	65.7	1.6	93	7.6		117	
Do	do	Sept. 27, 1940	30	14.0	8.5	81.9	1.0	46	7.5		89	
Do	do	Nov. 8, 1940	41	5.5	11.1	87.8	1.3	46	7.3		69	
South Fork Ten Mile Creek, ½ mile below Waynesburg, Pa.	MoTeSf 83.5	Aug. 21, 1940	5	22.0	.4	5.0	9.2	110,000	7.4		128	
Do	do	Sept. 27, 1940	33	13.5	7.6	72.4	6.3	2,400	7.5		94	
Do	do	Nov. 8, 1940	45	6.5	10.8	87.7	2.9	9,300	7.2		72	
Ten Mile Creek, upper edge of Marianna, Pa.	MoTe 75.5	Aug. 21, 1940	4	20.5	6.7	73.5	1.2	23	7.6		108	
Do	do	Sept. 27, 1940	18	11.5	9.0	82.0	1.1	150	7.7		131	
Do	do	Nov. 8, 1940	35	5.0	11.2	87.3	1.4	4	7.7		118	

[1] Seeded and neutralized.
[2] Less than 1.

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Ten Mile Creek, ½ mile below Marianna, Pa.	MoTe 74	Aug. 21, 1940	7	20.5	6.7	73.3	3.0	1,100	7.5	27	114	144
Do	do	Sept. 27, 1940	21	12.0	9.4	86.3	2.5	2,400	7.6	14	132	150
Do	do	Nov. 8, 1940	38	6.5	11.5	93.6	2.0	91	7.6	5	122	128
Monongahela River dam No. 5, Brownsville, Pa.	Mo 56.5	Aug. 19, 1940	730	26.0	7.3	88.8	.5; [1] .5	2	3.7			
Do	do	Aug. 27, 1940	1,600	22.5	7.8	89.1	.5; [1] .2	4	3.5			
Do	do	Sept. 4, 1940	2,820	22.0	8.0	90.8	.6; [1] .8	4	5.0			
Do	do	Sept. 13, 1940	1,700	20.5	8.3	91.4	1.2; [1] .7	([2])	4.1			
Do	do	Sept. 17, 1940	1,590	20.0	8.3	90.1	.9; [1] 2.7	2	4.0			
Do	do	Sept. 24, 1940	1,590	21.0	8.1	90.2	[1] .7; .1	([2])	3.6			
Do	do	Oct. 2, 1940	2,570	17.5	8.8	91.2	.7; [1] .6	2	4.4			
Do	do	Oct. 8, 1940	2,210	14.5	8.8	85.9	1.1; [1] .7	([2])	3.9			
Do	do	Oct. 17, 1940	1,150	15.0	8.7	86.1	1.0; [1] .8	1	3.9			
Do	do	Oct. 22, 1940	1,600	12.0	9.7	89.6	[1] .8; 1.5	([2])	3.8			
Do	do	Oct. 30, 1940	2,100	12.5	10.2	95.3	[1] 1.5; 2.7	2	3.8			
Do	do	Nov. 4, 1940	9,760	12.5	10.0	93.0	1.6; [1] 1.6	([2])	4.7			
Do	do	Nov. 12, 1940	2,980	10.0	10.8	95.0	1.2	([2])	6.8		10	
Do	do	Nov. 20, 1940	3,850	7.0	11.4	93.8	.7	([2])	6.5		7	
Do	do	Nov. 26, 1940	9,300	7.0	11.5	94.6	.8; [1] .8	([2])	4.3			
Do	do	Dec. 5, 1940	5,550	4.5	12.5	96.1	.3; [1] .4	([2])	5.7			
Do	do	Dec. 9, 1940	5,980	3.5	12.2	91.8	.6	1	6.2		7	

Dunlap Creek, ½ mile below mine, Fairbanks, Pa.	MoDu 67	Aug. 23, 1940	3	17.0	4.6	47.0	1.0	43	6.6	170	52	648
Do	do	Oct. 11, 1940	2	14.5	7.1	69.0	6.7 [1] 2.3	4	7.0	160	79	740
Do	do	Dec. 3, 1940	7	4.5	10.1	78.2	1.7	240	6.9	85	85	304
Dunlap Creek, ½ mile below Republic, Pa.	MoDu 65	Aug. 23, 1940	8	17.0	.1	1.1	8.0	230	6.5	----------	103	----------
Do	do	Oct. 11, 1940	10	12.5	4.3	39.9	10.2 [1] 1.5	36	6.2	----------	55	----------
Do	do	Dec. 3, 1940	26	4.0	8.2	62.8	2.3 [1] 1.8	43	6.9	85	103	----------
Redstone Creek, below Brownfield	MoRe 76	Aug. 22, 1940	(2)	16.0	8.1	81.6	.9	3	6.3	----------	10	----------
Do	do	Oct. 10, 1940	(3)	8.5	10.0	85.3	1.0	(2)	6.5	----------	7	----------
Do	do	Nov. 15, 1940	1	5.0	11.3	88.4	1.3	2	6.7	----------	21	----------
Redstone Creek above Treatment plant, Uniontown, Pa.	MoRe 73	Aug. 22, 1940	4	15.0	3.9	38.0	4.1 [1] 2.1	(2)	2.9	----------	----------	----------
Do	do	Oct. 10, 1940	6	10.0	7.2	63.8	1.4 7.4	(2)	3.2	----------	----------	----------
Do	do	Nov. 15, 1940	15	8.0	7.9	66.8	34.3 [1] 4.9	(2)	3.3	----------	----------	----------
Redstone Creek below treatment plant, Uniontown, Pa.	MoRe 71	Aug. 22, 1940	8	16.0	9.9	99.3	9.2 [1] 6.6	(3)	3.1	130	----------	1,180
Do	do	Oct. 10, 1940	8	6.5	6.7	54.0	14.4 [1] 11.6	(3)	3.1	155	----------	972
Do	do	Nov. 15, 1940	25	7.5	7.9	66.1	23.9 [1] 5.7	1	3.5	180	----------	776
Cove Run, at mouth, Uniontown, Pa.	MoReC 72.5	Aug. 22, 1940	1	15.0	3.7	36.2	17.5	4,600	7.6	17	202	195
Do	do	Oct. 10, 1940	1	8.5	4.0	34.4	5.0	2,400	7.5	8	170	178
Do	do	Nov. 15, 1940	7	4.5	8.5	65.2	3.9	2,400	7.1	5	89	148
Monongahela River dam No. 4, Charleroi, Pa.	Mo 41.5	Aug. 19, 1940	760	26.0	7.2	87.7	.8 .5	1	3.3	----------	----------	----------
Do	do	Aug. 27, 1940	1,910	22.5	8.4	96.5	.4 1.0	2	3.3	----------	----------	----------
Do	do	Sept. 4, 1940	2,900	21.5	8.2	92.1	1.4	75	6.3	64	24	82
Do	do	Sept. 13, 1940	1,680	20.0	8.6	93.2	.9 [1] .5	2	3.9	20	----------	----------
Do	do	Sept. 17, 1940	1,380	19.5	8.4	91.1	.7 [1] .7	(2)	3.7	6	----------	----------
Do	do	Sept. 24, 1940	900	21.0	7.9	87.3	.8 [1] .5	24	3.7	8	----------	----------
Do	do	Oct. 2, 1940	2,550	17.5	9.0	93.3	1.3 [1] .5	1	3.8	8	----------	----------
Do	do	Oct. 8, 1940	2,220	17.2	8.8	91.2	1.1 [1] .7	3	3.6	7	----------	168
Do	do	Oct. 17, 1940	1,010	15.0	9.4	92.1	.8 [1] .6	2	3.5	5	----------	80
Do	do	Oct. 22, 1940	1,650	11.5	10.2	93.5	[1] 1.0 1.4	2	3.5	6	----------	92
Do	do	Oct. 30, 1940	2,150	12.0	8.4	77.2	2.2 [1] .8	4	3.5	5	----------	81

[1] Seeded and neutralized.
[3] Less than 1

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, million	Coliforms, most probable per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					million	Percent tion						
Monongahela River dam No. 4 Charleroi, Pa.	Mo 41.5	Nov. 4, 1940	11,600	12.5	10.0	93.7	1.2 / [1] 1.0	(2)	4.6	4	----	67
Do	do	Nov. 12, 9140	2,570	10.0	10.7	94.2	1.2	1	6.1	8	4	79
Do	do	Nov. 20, 1940	4,650	7.0	11.4	93.3	.3 / [1] 1.0	(2)	4.3	5	----	80
Do	do	Nov. 26, 1940	10,600	7.0	11.2	92.2	1.2 / [1] 1.1	4	4.1	16	----	87
Do	do	Dec. 5, 1940	5,910	4.5	12.5	96.3	1.4 / [1] 1.6	(2)	5.7	10	----	72
Do	do	Dec. 9, 1940	6,040	4.0	12.1	91.9	.8 / [1] 1.1	1	4.6	8	----	88
Pigeon Creek, ¾ mile below Cokeburg, Pa.	MoPi 43.5	Aug. 21, 1940	(2)	17.0	8.6	88.1	2.0	240	7.6	----	141	----
Do	do	Sept. 27, 1940	1	9.5	10.5	92.0	2.0	93	7.6	----	137	----
Do	do	Nov. 8, 1940	2	4.5	11.9	91.6	1.4	43	7.7	----	123	----
Pigeon Creek, upper edge of Ellsworth, Pa.	MoPi 42.5	Aug. 21, 1940	2	18.5	4.4	46.3	1.8	9	7.5	----	127	----
Do	do	Sept. 27, 1940	5	9.5	8.8	76.7	2.1	----	7.6	----	125	----
Do	do	Nov. 8, 1940	5	5.5	10.4	82.0	2.3	9	7.3	----	122	----
Pigeon Creek, upper edge of Bentleyville, Pa.	MoPi 42	Aug. 21, 1940	3	17.5	8.4	86.6	2.5	1,100	7.6	----	125	----
Do	do	Sept. 27, 1940	5	9.5	6.4	81.6	3.0	240	7.5	----	150	----
Do	do	Nov. 8, 1940	8	5.5	10.9	86.2	2.0	460	7.4	----	126	----
Pigeon Creek below last sewer, Bentleyville, Pa.	MoPi 37.5	Aug. 21, 1940	3	15.5	8.7	86.3	1.9	240	7.5	8	114	231
Do	do	Sept. 27, 1940	5	9.0	9.9	85.1	3.0	1,100	7.6	17	118	202
Do	do	Nov. 8, 1940	9	5.0	11.3	88.0	2.0	230	7.4	37	108	178
North Fork Pigeon Creek at mouth, Bentleyville, Pa.	MoPiNf 40	Aug. 21, 1940	(2)	15.0	7.8	77.2	.5	4	6.6	76	232	250
Do	do	Sept. 27, 1940	1	8.5	8.1	68.8	7.1 / [1] 2.4	(2)	4.6	120	----	954
Do	do	Nov. 8, 1940	3	4.5	12.1	93.3	2.1	9	7.5	12	139	158
Monongahela River dam No. 3, McKeesport, Pa.	Mo 23.8	Sept. 25, 1940	2,100	22.0	8.1	91.7	.9 / [1] .8	(2)	3.7	----	----	----
Do	do	Oct. 4, 1940	2,200	17.5	8.6	88.9	1.6 / [1] 1.2	4	3.7	----	----	----
Do	do	Oct. 9, 1940	2,230	17.0	8.6	88.3	1.3 / [1] 1.1	1	3.5	----	----	----

Do	do	Oct. 18, 1940	1,900	15.0	9.1	89.3	1.1 [1] 1.2	(2)	3.5			
Do	do	Oct. 23, 1940	1,900	12.5	8.9	83.4	1.6 [1] 1.1	(2)	3.5			
Do	do	Nov. 1, 1940	8,360	13.0	9.8	92.8	1.9 [1] 1.4	(2)	3.4			
Do	do	Nov. 6, 1940	8,200	12.0	9.7	89.6	1.8	2	6.2		5	
Do	do	Nov. 13, 1940	3,250	10.0	10.2	90.2	1.0 [1] .8	(2)	4.6			
Do	do	Nov. 27, 1940	22,600	7.0	11.2	91.6	1.8 [1] 1.0	8	5.5			
Do	do	Dec. 4, 1940	13,600	3.0	12.4	92.0	.9	4	6.2		7	
Do	do	Dec. 10, 1940	21,100	5.0	12.3	96.2	1.6 1.1	1	5.5			
Monongahela River bridge above mouth of Youghiogheny River.	Mo 16.4	Aug. 19, 1940	780	28.0	2.3	29.0	.5 [1] .3	(2)	3.9			
Do	do	Aug. 27, 1940	1,960	23.5	3.4	39.5	1.2 [1] .4	2	3.7			
Do	do	Sept. 5, 1940	2,950	23.0	7.2	82.4	.6 [1] .5	2	4.5			
Do	do	Sept. 16, 1940	720	20.5	7.2	79.2	1.1 [1] .8	(2)	3.9			
Snowy Creek, Corinth, W. Va.	MoYoS 135	June 18, 1940	86	19.0	7.8	83.1	1.5 [1] 1.6	1,100	5.5	77	19	31
Do	do	June 24, 1940	18	17.5	8.3	85.8	.5	240	6.1	22	20	33
Do	do	July 8, 1940	21	14.5	9.3	90.4	.4	91	6.2	14		24
Youghiogheny River bridge at lower edge of Oakland, Md.	MoYo 127.5	June 18, 1940	374	20.0	7.6	82.4	.5 [1] .9	93	5.1	38	16	31
Do	do	June 24, 1940	390	18.0	8.2	86.1	.4 [1] .7	43	5.5	14	17	36
Do	do	July 8, 1940	133	16.0	8.7	87.8	.6 [1] .5	9	4.4	10		
Youghiogheny River above Confluence, Pa.	MoYo 88	July 16, 1940	378	20.5	8.4	92.3	.8 [1] .4	(2)	5.1		8	
Do	do	July 25, 1940	258	24.0	7.8	91.7	.2 [1] .3	1	5.6			
Do	do	Aug. 6, 1940	291	25.0	7.3	86.9	.3 [1] .4	15	4.6			
Casselman River bridge above town, Myersdale, Pa.	MoYoCa 116	July 15, 1940	61	18.5	8.1	86.2	1.5 [1] .2	(2)	3.3			
Do	do	July 24, 1940	122	21.5	7.4	83.4	.4 [1] .6	110	4.5			
Do	do	July 24, 1940	33	21.5	7.3	81.6	1.9 [1] .3	4	3.1			
Casselman River ½ mile below Meyersdale, Pa.	MoYoCa 113	July 15, 1940	73	18.0	8.6	89.9	1.0 [1] .4	9	3.0			
Do	do	July 24, 1940	125	21.5	7.4	83.2	.6 [1] 1.6	46	3.6			
Do	do	Aug. 2, 1940	35	20.0	8.3	90.9	.7 [1] .5	4	3.1			

[1] Seeded and neutralized.
[2] Less than 1.

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Casselman River, above Garrett, Pa.	MoYoCa 111	July 15, 1940	82	19.0	8.2	88.0	0.4 1.4	(2)	3.0			
Do	do	July 24, 1940	140	21.5	7.3	82.3	.9 [1] 1.4	46	3.4			
Do	do	Aug. 2, 1940	38	20.5	7.6	84.0	.4 1.4	4	3.0			
Buffalo Creek, at mouth, Garrett, Pa.	MoYoCaB-111	July 15, 1940	13	17.0	9.0	92.2	.7 1.5	240	3.5	14		
Do	do	July 24, 1940	13	21.5	8.2	92.1	.5 [1] 1.2	75	4.1	4		
Do	do	Aug. 2, 1940	6	17.5	8.9	92.5	.4 1.5	93	3.8	2		
Casselman River, 2 miles below Garrett, Pa.	MoYoCa 109	July 15, 1940	96	19.5	8.4	90.9	.5 1.6	(2)	3.2	5		
Do	do	July 24, 1940	150	22.5	7.6	86.9	1.3 [1] 1.7	110	3.5	10		
Do	do	Aug. 2, 1940	44	20.5	8.2	90.6	.4 1.2	4	3.0	4		
Casselman River, above Rockwood, Pa.	MoYoCa 105.5	July 16, 1940	250	19.5	8.4	90.7	1.0 1.5	9	3.4			
Do	do	July 25, 1940	142	25.0	7.5	89.3	.6 1.1	(2)	3.5			
Do	do	Aug. 6, 1940	40	23.0	7.9	91.2	.5 1.2	(2)	2.9			
Coxes Creek, above treatment plant	MoYoCaC-114	July 15, 1940		19.5	6.4	69.2	.8	150	6.6		26	
Do	do	July 24, 1940	9	23.0	.9	10.8	3.4	2,400	6.3		38	
Do	do	Aug. 2, 1940	1	19.5	10.0	107.9	.7	23	7.4		35	
Coxes Creek, below treatment plant, Somerset, Pa.	MoYoCaC-111	July 15, 1940	8	20.5	6.9	76.1	1.3	91	6.7	18	24	71
Do	do	July 24, 1940	10	23.5	1.8	20.5	2.9	2,400	6.4	135	44	77
Do	do	Aug. 2, 1940	2	19.5	1.6	17.7	47.4	4,600	6.8	80	87	
Coxes Creek, at mouth, Rockwood, Pa.	MoYoCaC 104.5	July 16, 1940	93	19.0	8.8	94.2	.9 1.8	23	5.2	60	8	
Do	do	July 25, 1940	32	23.5	8.1	94.3	.5	93	6.8	10	23	68
Do	do	Aug. 6, 1940	4	21.5	7.6	85.1	.9 1.3	46	3.6	4		

Casselman River Bridge, below town, Rockwood, Pa.	MoYoCa 104	July 16, 1940	343	20.0	8.6	93.2	1.0 [1].4	24	3.9			
Do	do	July 25, 1940	174	25.0	7.9	93.9	.5 [1].2	46	3.8			
Do	do	Aug. 6, 1940	45	23.5	8.1	93.8	.6 [1].2	(2)	2.9	2		
Casselman River at mouth, Confluence, Pa.	MoYoCa 87	July 16, 1940	322	20.0	8.6	93.8	.7 [1].4	9	3.9	7		
Do	do	July 25, 1940	248	23.0	8.0	92.6	.3 [1].2	2	3.9	3		
Do	do	Aug. 6, 1940	87	23.5	7.9	91.5	.5 [1].1	(2)	3.7	3		
Laurel Hill Creek at mouth, Confluence, Pa.	MoYoLa 86.5	July 16, 1940	230	19.0	8.7	93.4	.7	460	7.0	50	23	31
Do	do	July 25, 1940	75	23.5	8.2	95.8	.3	4	7.0	4	17	28
Do	do	Aug. 6, 1940	32	22.5	7.8	89.3	.2	4	6.9	7	17	31
Youghiogheny River, ½ mile below Confluence, Pa.	MoYo 84.5	July 16, 1940	930	21.0	8.4	93.0	.4 [1].5	46	5.1	8	7	
Do	do	July 25, 1940	581	25.0	7.9	94.3	.7 [1].3	4	5.6	4		
Do	do	Aug. 6, 1940	410	25.5	7.3	88.3	.6 [1].3	15	4.7	5		
Youghiogheny River water plant intake above Connellsville, Pa.	MoYo 59	Aug. 30, 1940	2,470	19.0	8.8	93.8	.6	24	6.8		8	
Do	do	Oct. 1, 1940	308	13.0	9.5	89.8	.5	(2)	6.9		6	
Do	do	Nov. 18, 1940	1,005	2.0	13.2	95.1	1.1	(2)	7.1		8	
Mounts Creek, at mouth, Connellsville, Pa.	MoYoM 58	Aug. 30, 1940	3	20.5	8.5	93.4	.6	1,100	7.4	4	31	124
Do	do	Oct. 1, 1940	3	12.0	10.0	92.0	.6	43	7.3	3	24	129
Do	do	Nov. 18, 1940	10	1.0	13.3	93.3	2.2	460	7.3	5	32	80
Youghiogheny River, ½ mile below Connellsville, Pa.	MoYo 57	Aug. 30, 1940	2,490	19.5	8.4	90.5	2.0	2,400	6.7	16	12	32
Do	do	Oct. 1, 1940	308	13.0	9.7	91.4	.4	36	7.0	4	2	42
Do	do	Nov. 18, 1940	1,020	2.0	13.2	95.2	1.6	1,100	6.9	3	12	42
Dickerson Run, ½ mile above Vanderbilt, Pa.	MoYoD 53.5	Dec. 3, 1940	2	1.5	13.2	94.2	1.0	9	7.4		168	
Dickerson Run, upper edge of Vanderbilt, Pa.	MoYoD 53	Aug. 30, 1940	14	19.5	8.7	93.7	.7	240	7.0		58	
Do	do	Oct. 1, 1940	(2)	11.0	9.5	85.5	3.5 [1]3.0	23	4.6			
Do	do	Nov. 18, 1940	(2)	1.5	13.3	94.9	2.6	2,400	7.9		144	
Dickerson Run, West Branch, upper edge of Vanderbilt, Pa.	MoYoDWb-53	Dec. 3, 1940	(2)	1.5	13.0	92.7	1.8 [1]2.2	460	5.6	16		309
Dickerson Run, 1 mile below town, Vanderbilt, Pa.	MoYoD 52	Aug. 30, 1940	2	19.5	8.5	92.1	1.0	2,400	7.6	20	74	224
Do	do	Oct. 1, 1940	(2)	11.5	9.5	86.5	.9	36	7.4	4	46	294
Do	do	Nov. 18, 1940	1	2.0	13.0	93.6	2.0	460	7.5	6	86	267
Do	do	Dec. 3, 1940	3	0	13.1	89.5	4.6	1,100	7.3	40	115	230

[1] Seeded and neutralized.
[2] Less than 1.

TABLE MO-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Washington Run, ¼ mile above town, Star Junction, Pa.	MoYoW 51	Aug. 30, 1940	([2])	20.0	6.9	75.4	1.3	240	7.5		22	
Do	do	Oct. 1, 1940	([2])	12.0	6.7	61.8	1.6	23	7.5		230	
Do	do	Nov. 18, 1940	([2])	5.0	9.3	73.0	1.2	4	7.5		205	
Washington Run, ½ mile below Star Junction, Pa.	MoYoW 49.5	Aug. 30, 1940	([2])	20.5	7.2	79.7	1.1 1.9	7	4.8	27		268
Do	do	Oct. 1, 1940	([2])	12.5	6.6	61.5	.9	23	6.7	14	32	273
Do	do	Nov. 18, 1940	1	4.0	9.5	72.4	2.8	24	6.5	17	41	270
Shutes Run, upper edge of town, Mount Pleasant, Pa.	MoYoJaS 62	Sept. 3, 1940	1	19.5	5.1	55.5	5.6	2,400	6.9		76	
Do	do	Sept. 26, 1940	1	10.5	8.4	74.8	2.8	1,100	7.1		104	
Shutes Run, ¼ mile below last sewer, Mount Pleasant, Pa.	MoYoJaS 60	Sept. 3, 1940	1	18.5	0	0	147.0	240,000	7.3	170	187	266
Do	do	Sept. 26, 1940	2	11.0	4.2	38.3	62.4	46,000	7.4	115	169	265
Jacob Creek, upper edge of Scottdale, Pa.	MoYoJa 55.5	Sept. 3, 1940	13	19.0	6.6	70.4	1.0	23	6.3		20	
Do	do	Sept. 26, 1940	31	12.5	8.5	79.1	1.9	93	6.8		16	
Jacob Creek, ½ mile below Scottdale, Pa.	MoYoJa 53	Sept. 3, 1940	17	18.5	4.7	50.2	1.0 [1] 1.1	7	5.4	14		
Do	do	Sept. 26, 1940	37	12.0	8.0	74.3	2.1	75	6.4	14	9	94
Youghiogheny River, upper edge of West Newton, Pa.	MoYo 35	Sept. 19, 1940	845	18.0	8.1	84.9	.4 1.6	([2])	4.5			
Do	do	Nov. 7, 1940	3,150	7.0	10.9	89.4	1.8	46	7.2			
Do	do	Dec. 2, 1940	5,720	2.5	12.6	91.9	1.6	24	6.6		13	
Youghiogheny River, ½ mile below West Newton, Pa.	MoYo 33	Sept. 19, 1940	845	18.0	8.2	85.7	.6 1.5	1	4.5	6		77
Do	do	Nov. 7, 1940	3,150	7.5	10.7	89.1	1.9	46	7.1	4	6	51
Do	do	Dec. 2, 1940	5,720	2.5	12.6	92.2	.8	24	6.7	4	7	45
Jacks Run, upper edge of Greensburg, Pa.	MoYoSJ 58	Sept. 18, 1940	6	16.0	22.4	224.6	3.3 1.8	([2])	2.7			
Do	do	Oct. 29, 1940	([2])	8.5	6.1	52.0	17.4 [1] 4.2	([2])	2.9			
Jacks Run, above mouth Slate Creek, Greensburg, Pa.	MoYoSJ 53.5	Oct. 15, 1940	10	15.5	12.8	127.3	160.8 22.0	36	3.5	220		2,400
Do	do	Oct. 25, 1940		12.5	5.3	49.5	140.0 [1] 74.0	36	3.5	180		2,820
Do	do	Nov. 1, 1940	10	13.5	0	0	161.0 [1] 170.0	240,000	6.3	950	51	296
Do	do	Nov. 7, 1940	10	11.0	9.2	83.1	148.4 [1] 53.4	23	3.5	180		2,260

Do	do	Nov. 15, 1940	9	9.5	14.4	125.6	116.0 [1]33.6	2	3.5	190	----------	2,510
Do	do	Nov. 22, 1940	9	15.0	13.2	130.0	138.8 [1]40.0	2	3.5	150	----------	2,380
Do	do	Nov. 28, 1940	19	6.5	7.7	62.8	72.0 [1]17.5	360	4.4	70	----------	1,540
Do	do	Dec. 2, 1940	18	5.5	10.6	83.6	112.8 [1]31.8	23	4.1	110	----------	1,670
Slate Creek, at mouth, Greensburg, Pa.	MoYoSJS 54.5	Oct. 15, 1940	1	13.5	0	0	45.9	15,000	7.2	75	107	101
Do	do	Oct. 25, 1940	----------	9.5	2.4	21.2	29.6	9,300	6.9	80	86	99
Do	do	Nov. 1, 1940	6	10.5	6.6	58.9	26.8	2,400	6.9	70	59	96
Do	do	Nov. 7, 1940	6	8.5	10.4	88.8	6.8	430	7.3	10	50	80
Do	do	Nov. 15, 1940	3	5.0	10.5	81.9	14.5	11,000	6.9	9	57	136
Do	do	Nov. 22, 1940	3	12.0	8.6	79.2	14.8	4,600	7.2	32	66	116
Do	do	Nov. 28, 1940	23	3.5	11.8	88.8	4.8	390	6.9	22	27	88
Do	do	Dec. 2, 1940	5	2.5	12.0	87.6	17.9	1,500	7.0	24	46	----------
Jacks Run, below Slate Run, below Greensburg, Pa.	MoYoSJ 53	Sept. 18, 1940	11	13.0	6.8	64.1	4.6 [1]1.6	(2)	3.1	320	----------	----------
Do	do	Sept. 24, 1940	7	14.5	6.6	64.3	5.6 [1]4.6	1	3.5	125	----------	798
Do	do	Sept. 24, 1940	7	19.0	0	0	184.6 [1]138.4	2,400	4.7	1,500	----------	384
Do	do	Sept. 27, 1940	8	10.5	7.1	62.9	6.8 [1]5.3	(2)	3.3	90	----------	1,810
Do	do	Sept. 27, 1940	7	17.5	10.6	109.9	4.7 [1]6.5	4	3.3	72	----------	2,040
Do	do	Oct. 29, 1940	4	11.0	5.6	50.4	33.2 [1]32.0	4	3.3	145	----------	852
Jacks Run, upper edge of Youngwood, Pa.	MoYoSF 52.5	Sept. 3, 1940	13	16.5	.9	8.8	12.9	36	6.3	----------	5	----------
Do	do	Sept. 26, 1940	16	10.0	8.6	75.7	8.6 [1]7.8	24	6.0	----------	19	----------
Jacks Run, below last sewer, Youngwood, Pa.	MoYoSJ 51	Sept. 3, 1940	15	16.5	1.0	9.6	13.1	1,500	6.4	88	3	316
Do	do	Sept. 26, 1940	17	10.0	9.0	79.1	9.0 [1]7.4	93	6.0	125	12	472
Sewickley Creek, above mouth Jacks Run, Youngwood, Pa.	MoYoS 51	Sept. 3, 1940	28	15.5	7.8	77.3	7.2 [1]1.7	(2)	3.3	190	----------	----------
Do	do	Sept. 26, 1940	36	10.0	9.6	84.7	8.6 [1]2.2	(2)	3.7	200	----------	----------
Youghiogheny River, bridge above Versailles, Pa.	MoYo 20	Sept. 19, 1940	865	18.0	7.8	81.8	.7 [1].6	2	3.8	----------	----------	----------
Do	do	Nov. 7, 1940	3,210	6.5	10.6	86.4	1.3	16	7.0	----------	8	----------
Do	do	Dec. 2, 1940	5,770	1.5	12.2	86.9	.2	21	6.2	----------	9	----------
Youghiogheny River, 1 mile below Versailles, Pa.	MoYo 18	Sept. 19, 1940	865	18.5	7.6	80.5	.6 [1].6	2	3.8	----------	----------	----------
Do	do	Nov. 7, 1940	3,210	6.5	10.4	84.7	1.8	4	7.1	----------	5	----------
Do	do	Dec. 2, 1940	5,780	2.0	12.2	88.1	.7	24	6.2	----------	8	----------

[1] Seeded and neutralized.
[2] Less than 1.

TABLE MO–7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness parts per million
Youghiogheny River, at mouth McKeesport, Pa.	MoYo 16.3	Aug. 19, 1940	425	25.0	6.2	73.7	1.4 [1].4	2	3.5	17	----------	----------
Do	do	Aug. 27, 1940	3,260	18.5	7.2	76.1	1.0 [1].4	8	3.5	75	----------	----------
Do	do	Sept. 5, 1940	1,050	21.0	7.4	81.8	.2 [1].4	2	4.1	18	----------	----------
Do	do	Sept. 16, 1940	875	18.0	7.6	79.1	1.4 [1]1.0	110	4.0	14	----------	----------
Do	do	Sept. 25, 1940	490	17.0	7.2	74.0	1.2 [1]1.0	2	3.4	7	----------	----------
Do	do	Oct. 4, 1940	883	15.0	8.6	84.5	1.1 [1].6	1	3.1	20	----------	----------
Do	do	Oct. 9, 1940	610	14.5	8.4	81.5	1.1 [1].5	(2)	3.3	8	----------	220
Do	do	Oct. 18, 1940	530	11.0	8.6	77.7	3.5 [1]1.2	24	3.6	140	----------	----------
Do	do	Oct. 23, 1940	485	9.5	10.1	88.2	1.4 [1].6	(2)	4.0	14	----------	186
Do	do	Nov. 1, 1940	2,550	10.5	9.7	86.9	1.8 [1]1.2	4	4.6	18	----------	94
Do	do	Nov. 6, 1940	2,800	9.0	10.6	91.7	1.0	2	6.9	14	6	66
Do	do	Nov. 13, 1940	1,480	7.5	9.5	79.3	.8 [1].7	2	4.5	14	----------	157
Do	do	Nov. 27, 1940	5,880	9.0	10.6	91.6	1.4	15	6.2	105	13	90
Do	do	Dec. 4, 1940	3,420	0	13.1	89.6	.6	2	6.2	55	9	118
Do	do	Dec. 10, 1940	3,830	5.0	12.1	94.7	.6	4	6.2	50	10	124
Brush Creek, upper edge of Jeanette, Pa.	MoTuB 31	Sept. 18, 1940	1	17.0	9.5	97.3	.8	15	7.7	----------	44	----------
Do	do	Oct. 29, 1940	(2)	8.5	10.3	87.9	6.1	46	7.3	----------	58	----------
Brush Creek, above treatment plant, Jeanette, Pa.	MoTuB 28	do	2	16.5	2.1	21.0	85.8	24,000	7.9	95	146	111
Brush Creek, 200 feet below treatment plant, Jeanette, Pa.	MoTuB 27.5	Sept. 18, 1940	7	22.0	1.0	11.1	53.3	46,000	7.1	41	141	110
Do	do	Oct. 29, 1940	5	13.5	0	0	50.7	110,000	7.3	----------	182	----------
Brush Creek, above Irvin, Pa.	MoTuB 25	Sept. 19, 1940	13	18.0	7.9	82.6	6.8 [1]6.2	(2)	3.2	----------	----------	----------

Do	do	Nov. 7, 1940	12	6.5	10.8	87.9	2.5 [1] 3.4	24	3.3			
Do	do	Dec. 2, 1940	30	2.5	11.8	86.4	2.1 [1] 2.3	240	3.5			
Brush Creek, ½ mile below Irvin, Pa.	MoTuB 23	Sept. 19, 1940	15	16.5	7.7	78.4	6.2 [1] 4.8	2	3.6	225		557
Do	do	Nov. 7, 1940	18	8.0	10.2	85.8	15.4 [1] 5.7	8	3.4	190		704
Do	do	Dec. 2, 1940	38	4.5	11.4	87.7	9.1 [1] 3.9	240	3.8	150		382
Turtle Creek, upper edge of Export, Pa.	MoTu 28	Sept. 18, 1940	1	18.5	6.4	67.7	5.6 [1] 1.0	([2])	2.8			
Do	do	Oct. 29, 1940	([2])	8.5	8.4	71.8	4.8 [1] 2.5	([2])	3.1			
Turtle Creek, ¾ mile below Export, Pa.	MoTu 25.5	Sept. 18, 1940	4	14.0	7.8	74.8	2.5 [1] .6	([2])	2.9	87		472
Do	do	Oct. 29, 1940	2	9.0	9.7	83.4	2.4 [1] 1.6	([2])	3.1	16		599
Turtle Creek, above all sewage above Trafford, Pa.	MoTu 18.5	Sept. 6, 1940	10	21.5	8.2	92.3	.7 [1] .6	([2])	2.9			
Do	do	Oct. 28, 1940	6	8.5	11.1	94.5	.9 [1] 1.1	([2])	3.2			
Do	do	Nov. 28, 1940	165	2.0	12.5	90.6	.8	4	6.0		4	
Turtle Creek, above mouth Brush Creek, below Trafford, Pa.	MoTu 17.5	Sept. 6, 1940	12	21.0	4.0	44.3	5.0 [1] 6.9	240	3.3			
Do	do	Oct. 28, 1940	6	10.5	8.3	74.4	17.0 [1] 17.2	150	3.5			
Do	do	Nov. 28, 1940	170	2.0	12.6	91.4	1.9	430	6.0		5	
Turtle Creek, upper edge of Pitcairn, Pa.	MoTu 16	Sept. 6, 1940	38	20.0	5.4	58.5	6.4 [1] 7.4	([2])	3.3			
Do	do	Oct. 28, 1940	153	8.5	8.9	76.0	10.1 [1] 2.6	([2])	3.2			
Do	do	Nov. 28, 1940	309	2.5	12.2	89.1	1.2	91	6.1		7	
Turtle Creek, upper edge of Turtle Creek, Pa.	MoTu 14.5	Sept. 6 1940	53	19.0	4.1	44.2	6.0 [1] 5.9	([2])	2.9			
Do	do	Oct. 28, 1940	31	9.5	9.7	84.9	10.8 [1] 6.0	([2])	2.9			
Do	do	Nov. 28, 1940	314	2.5	12.3	90.0	2.1	1,100	6.2		8	
Turtle Creek, ½ mile above mouth, Turtle Creek, Pa.	MoTu 12	Sept. 6, 1940	56	24.0	2.8	33.2	5.1 [1] 15.0	4	2.9	47		451
Do	do	Oct. 28, 1940	34	13.0	5.5	51.9	12.7 [1] 14.6	2	3.2	65		478
Do	do	Nov. 28, 1940	321	3.0	11.6	85.7	3.3	36	6.2	65	9	199
Monongahela River dam No. 2, Pittsburgh, Pa.	Mo 11.2	Aug. 19, 1940	1,200	19.0	5.4	57.5	.6 [1] .2	1	3.5	8		
Do	do	Aug. 27, 1940	5,200	24.0	6.0	70.0	.7 [1] .5	46	3.7	3		
Do	do	Sept. 5, 1940	4,060	23.5	7.3	84.7	1.3 [1] 1.0	4	3.9	8		

[1] Seeded and neutralized.
[2] Less than 1.

TABLE Mo-7.—*Monongahela River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Monongahela River dam No. 2, Pittsburgh, Pa.	Mo 11.2	Sept. 16, 1940	1,650	21.0	7.1	79.3	1.4; [1] 1.2	9	3.9			
Do	do	Sept. 25, 1940	2,620	23.0	6.0	69.5	1.7; [1] 1.5	9	4.0			
Do	do	Oct. 4, 1940	3,090	19.0	7.3	78.4	1.4; [1] 1.0	2	3.7			
Do	do	Oct. 9, 1940	2,840	20.0	6.1	66.5	1.4; [1] 1.0	3	3.8			159
Do	do	Oct. 18, 1940	2,450	18.5	6.4	67.9	2.2; [1] 1.5	2	3.7			
Do	do	Oct. 23, 1940	2,450	13.5	7.6	72.1	1.8; [1] 1.0	([2])	3.7			
Do	do	Nov. 1, 1940	12,400	13.5	9.1	86.5	2.4; [1] 1.8	24	3.4			
Do	do	Nov. 6, 1940	11,130	12.5	9.4	88.0	1.1		6.7		5	
Do	do	Nov. 13, 1940	4,800	10.7	9.1	81.4	1.8; [1] 1.3	14	4.2			
Do	do	Nov. 27, 1940	29,500	6.5	10.7	86.9	1.5; [1] 1.3	4	5.3			
Do	do	Dec. 4, 1940	17,600	3.5	12.0	90.2	1.7	4	6.4		10	
Do	do	Dec. 10, 1940	25,900	5.5	11.6	91.9	2.8	19	6.1		11	
Nine Mile Run, upper edge of Wilkinsburg, Pa.	MoNi 10	Sept. 6, 1940	([2])	17.0	8.0	82.4	1.4	1,100	7.4		103	
Do	do	Oct. 28, 1940	1	12.0	7.6	69.7	2.0	230	7.7		125	
Do	do	Nov. 28, 1940	2	6.5	10.6	86.0	1.5	240	7.5			
Nine Mile Run, 4 miles below Wilkinsburg, Pa.	MoNi 6.5	Sept. 6, 1940	1	17.0	6.0	61.7	2.7; [1] 2.1	4	9.6	5	97	176
Do	do	Oct. 28, 1940	1	11.0	4.8	43.0	7.8; [1] 8.4	15	9.6	15	58	178
Do	do	Nov. 28, 1940	2	9.5	7.5	65.8	7.2; [1] 7.0	1,100	9.4		57	
Monongahela River, at mouth, Pittsburgh, Pa.	Mo 0.05	Sept. 16, 1940	1,650	20.0	4.6	49.9	1.0; [1] .8	43	5.5	55		137
Do	do	Sept. 25, 1940	2,620	24.0	1.3	15.7	2.1; [1] 3.3	11	3.8	6		
Do	do	Oct. 4, 1940	3,090	19.5	5.2	55.8	1.4; [1] 1.4	4	3.7	14		

Do	do	Oct. 9, 1940	2,840	19.5	3.8	41.3	1.6 [1] 1.7	240	4.4	12		143
Do	do	Oct. 18, 1940	2,450	18.5	3.6	38.6	2.2	23	3.9	12		14
Do	do	Oct. 23, 1940	2,450	17.0	3.9	39.8	3.1 [1] 1.8	4	3.9	4		94
Do	do	Nov. 1, 1940	12,400	15.0	7.9	77.9	2.9 [1] 1.8	4	3.5	4		142
Do	do	Nov. 6, 1940	11,130	12.5	10.1	93.9	1.3	9	6.6	4	5	76
Do	do	Nov. 13, 1940	4,800	12.0	7.7	71.0	2.9 [1] 2.6	46	4.3	18		100
Do	do	Nov. 27, 1940	29,500	7.0	9.6	79.0	3.0	46	6.1	16	8	103
Do	do	Dec. 4, 1940	17,600	4.0	12.2	92.8	2.4	9	6.3	4	10	68
Do	do	Dec. 10, 1940	25,900	4.0	11.3	86.1	1.8	2	6.3	5	18	82

[1] Seeded and neutralized.
[2] Less than 1.

TABLE Mo-7A.—*Monongahela River Basin: Laboratory data—Acid stream results*

Stream	Sampling point	Month, 1940	Number of samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Brown Creek	Mouth, Two Lick, W. Va., mile 166	June	2	2.9	252	406	324	6.7	75
		July	1	3.2			164	15.0	50
West Fork River	Above Clarksburg, W. Va., mile 160	May	3	6.2			11		
		June	3	6.7			6		
		July	1	6.5			2		
Elk Creek	Above Nutter Fort, W. Va., mile 167	May	3	6.8			17		[1] 2
		June	3	6.9			4		
		July	1	6.4			2		
Anmore Creek	Below Anmore, W. Va., mile 165	May	1	3.2	60	122	108		14
		June	4	4.1	[2] 106	[2] 151	107		18
		July	1	6.3			2		3
Elk Creek	West Pike St. Branch, Clarksburg, W. Va., mile 159	July	1	4.6	18	56	37		4.0
	Mouth, Clarksburg, W. Va., mile 158	May	3	6.2			15		[1] 3.0
		June	3	6.4			10.7		[3] 3.6
		July	2	5.9		35	14.5		2.8
West Fork River	Adamston Branch, Clarksburg, W. Va., mile 158	May	3	6.3			12		[1] 4.0
		June	3	6.7			6.4		
		July	1	6.0			2.0		4.0
Limestone Run	Below milk plant, Clarksburg, W. Va., mile 157	May	1	4.4	9	72	32		15
		June	4	5.0	[3] 17	[1] 83	43	[1] .6	22
		July	1	5.6			12		12
West Fork River	Perry Mines, W. Va., mile 155	May	3	6.3			15		
		June	3	6.6			7		[1] 5.6
		July	1	6.1			2		
	Above Zeising, W. Va., mile 150	May	3	5.7		[1] 10	19		[1] 3.5
		June	3	6.4			8		3.8
		July	2	5.2	[1] 17	[1] 41	15		3.7
Simpson Creek	Above Bridgeport, W. Va., mile 162	May	1	2.9	182	305	252		15
		June	4	3.0	302	340	312	[3] .47	44
		July	1	3.1	38	48	44		35
	Below Bridgeport, W. Va., mile 156	May	1	3.1	110	178	144		20
		June	4	3.2	148	226	202		22
		July	1	3.4	44	52	48		40
Ten Mile Creek	Below Salem, W. Va., mile 168.5	May	1	7.1			14		
		June	4	6.9			12		[1] 1.6
		July	1	6.4			2		
	Below East Salem, W. Va., mile 167.5	May	1	7.0			8		
		June	4	6.8			9.5		[1] 1.4
		July	1	6.4			2		
	Above Lumberport, W. Va., mile 148	May	1	5.8		7	6		
		June	4	6.4			6.2		[1] 7.0
		July	1	6.1			6.0		

West Fork River, mile 128.1	Mouth, Lumberport, W. Va., mile 147	May	1	4.6		8	14		.5
		June	4	5.7	[1] 6	[1] 16	8.5		[2] 3.0
		July	1	5.6			6		1.4
	Below Ten Mile Creek, mile 145	June	4	3.9	42	[2] 105	68	12	
		July	1	4.4	10		16		
	Below Shinnston, W. Va., mile 143	May	1	3.5	17	40	32		.6
		June	4	3.8	41	82	66		11
		July	1	4.6	8		18		8
	Above Worthington, W. Va., mile 138	May	1	5.7		30	16		
		June	2	3.6	26	54	42		7
	Below Monongah, W. Va., mile 132	May	2	4.8	[1] 30	44	32		
		June	3	3.5	32	[3] 58	44		[3] 7.5
	Mouth, Fairmont, W. Va., mile 128	May	2	4.9		[1] 20	[1] 16		
		June	3	3.9	25	46	39		[3] 1.4
Grassy Run (Tygart River)	Mouth, Norton, W. Va., mile 202	July	1	2.5			1,318	3.2	800
Three Forks Creek	Grafton, W. Va., mile 149.5	June	2	5.7		[1] 4	4.5		.67
Monongahela River	Highway bridge in Fairmont, W. Va., mile 126.7	May	2	4.7		33	25		
		June	3	4.6	[1] 18	21	16		
Buffalo Creek, mile 125.0	Above Mannington, W. Va., mile 145	May	1	6.6			8		.2
		June	4	6.8			4.5		
		July	1	5.9			2		
	Below Mannington, W. Va., mile 140.7	May	1	6.4			4		
		June	4	6.8			5		[1] .4
		July	1	5.8			2		
	Mouth, Fairmont, W. Va., mile 127	May	2	5.8		[1] 22	9		
		June	3	6.4		[1] 24	7.3		
Monongahela River	Railroad bridge below Fairmont, W. Va., mile 124.2	May	2	[1] 6.6		18	12		
		June	3	4.5	[1] 14	20	16		[3] 1.6
	Lock and dam No. 11, Morgantown, W. Va., mile 104.1	May	2	4.0	[1] 60	53	44		
		June	4	4.8	[3] 9	19	12		[3] 1.3
Deckers Creek, mile 101.0	Above Sabraton, W. Va., mile 104	do	4	4.6	[2] 9	21	13		[1] .2
	Below shirt factory, Morgantown, W. Va., mile 103	May	2	4.6	[1] 12	23	16		
		June	4	4.6	[3] 13	[2] 26	20		[1] .2
	Mouth, Morgantown, W. Va., mile 101	May	2	4.7	[1] 6	18	11		
		June	4	4.9	[3] 6	21	14		[1] .2
Monongahela River	Branch in Morgantown, W. Va., mile 100.9	May	2	4.0	[1] 52	46	39		
		June	4	4.9	[3] 7	15	8		[1] 1.6
	Star City (Ferry), W. Va., mile 97.7	May	2	4.4		47	40		
		June	4	4.4	[1] 7	[2] 26	17		[3] 1.8
	Lock and dam No. 8, Point Marion, Pa., mile 90.6	May	1	5.0			12		
		June	2	4.5			16		1.4
		August	2	3.3	37	53	46		1.9
		September	4	3.4	35	44	43		1.8
		October	5	3.8	18	21	20		1.3
		November	4	4.3	7	15	14		[2] 1.7
		December	2	4.1	[1] 7	[1] 22	18		2.2
Blackwater River (Cheat River Basin), mile 170.8.	Davis, W. Va., mile 183	June	2	6.7					.79
		July	1	6.7					.66
	Above Thomas, W. Va., mile 181	June	2	5.6		10	8		1.22
		July	1	5.5			9		
	Below Thomas, W. Va., mile 180	June	1	5.5	12	34	26		3.8
		July	1	5.3			13		5.4
	Mouth, Hendricks, W. Va., mile 171	June	2	4.8	[1] 11	22	17		3.9
		July	1	4.6					1.7

[1] 1 sample. [3] 3 samples. [2] 2 samples.

TABLE Mo-7A.—*Monongahela River Basin: Laboratory data—Acid stream results*—Continued

Stream	Sampling point	Month, 1940	Number of samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Green Run Creek	Between Kingwood and Albright, W. Va., mile 118.5	June	2	3.6	34	52	45		4.0
		July	1	3.3			88	0.30	
Cheat River, mile 89.1	Ices Ferry, W. Va., mile 100.5	May	1	6.5			6		
		June	2	6.3			4		
	Mouth, Point Marion, Pa., mile 89.1	May	1	6.4			8		
		June	2	5.0	[1] 16	[1] 32	13		1.7
Monongahela River	Lock and dam No. 7, mile 84.8	May	1	5.7			16		
		June	2	4.1	[1] 20	[1] 35	19		[1] 4.0
		August	2	3.3	34	49	43		2.5
		September	4	3.8	25	35	31		1.4
		October	5	3.8	11	21	16		1.9
		November	2	4.5	4	11	9		1.6
		December	2	4.2	[1] 6	[1] 20	18		2.2
Muddy Creek	Above Fairchance, Pa., mile 96.0	August	1	3.9	26	48	40		1.4
		October	1	5.3	12	26	15		3.3
		November	1	5.3			12		4.5
Georges Creek	Below Smithfield, Pa., mile 91.5	August	1	3.6	45	75	60		.6
		October	1	4.2	20	67	37		1.5
		December	1	5.6			16		4.4
Jacobs Creek	Greensboro, Pa., mile 84	October	2	5.5	[1] 60	75	66	[1] 8.0	22
Cats Creek	Below Masontown, Pa., mile 81	August	1	2.5	1,978	296	2,510	108	397
		October	1	2.5	1,870	2,734	2,374	127	367
		December	1	2.9			2,064	90	345
Monongahela River	Lock and dam No. 6, mile 68.3	August	2	3.3	43	60	54		2.3
		September	4	3.4	34	45	49		1.5
		October	5	3.6	20	30	27		1.2
		November	3	4.3	10	20	19		1.7
		December	2	4.9	[1] 2	[1] 15	14		1.1
	Lock and dam No. 5, mile 56.5	August	2	3.6	22	33	30		1.2
		September	4	4.2	[2] 22	[2] 34	32		.9
		October	5	3.9	14	23	19		1.4
		November	2	4.5	7	21	15		2.2
		December	1	5.7	3	16	12		1.5
Dunlop Creek, mile 56	Below New Salem, Pa., mile 67	October	1	7.0			37	12	24.6
	Below Republic, Pa., mile 61	do	1	6.2	2	172	237	78.3	103
		December	1	6.9			90	12	56
Redstone Creek, mile 55	Above Uniontown, Pa., mile 74	August	1	2.9	533	1,016	965	162	425
		October	1	3.2	1,076	1,682	1,416	155	361
		November	1	3.3			1,180	286	428
	Below Uniontown, Pa., mile 73	August	1	3.1	308	759	660	159	310
		October	1	3.1	334	786	650	136	175
		November	1	3.5			640	164	258

Monongahela River	Lock and dam No. 4, mile 41.5	August	2	3.3	43	69	55		2.4
		September	3	3.8	20	34	27		1.9
		October	5	3.6	22	35	29		1.5
		November	3	4.3	8	18	20		5.1
		December	2	5.1		[1] 11	11		4
North Fork Piegon Creek	Mouth, Bentleyville, Pa., mile 40	September	1	4.6	65	435	467	158	159
Monongahela River	Lock and dam No. 3, mile 23.8	do	1	3.7	19	34	28		1.4
		October	4	3.6	19	30	27		1.9
		November	3	4.5	13	23	18		5.4
		December	1	5.5			18	1.8	4.8
	Above mouth Youghiogheny, mile 16	August	2	3.8	26	55	43		3.1
		September	2	4.2	7	18	27		3.4
Snowy Creek (Youghiogheny)	Corinth, W. Va., mile 135	June	1	5.5		7	8		3.8
Youghiogheny River	Below Oakland, Md., mile 128	do	2	5.3		14	13		4.3
		July	1	4.4			17		1.3
	Above Confluence, Pa., mile 86	do	2	5.3		9	6		.4
		August	1	4.4			3		2.4
Casselman River	Above Meyersdale, Pa., mile 116	July	2	3.9	[1] 63	[1] 110	103	6.7	27.3
		August	1	3.1			112	6	7
	Below Meyersdale, Pa., mile 113	July	2	3.3	60	91	79	5.7	26
		August	1	3.1			116	2.2	9
	Above Garrett, Pa., mile 111	July	2	3.2	52	80	67	[1] .68	15
		August	1	3.0			100		22
Buffalo Creek	Mouth, Garrett, Pa., mile 111	July	2	3.5	20	40	29	[1] 1.9	3.7
		August	1	3.8			19		.8
Casselman River	Below Garrett, Pa., mile 109	July	2	3.4	42	68	55	[1] .1	4.6
		August	1	3.0			87		4.2
	Above Rockwood, Pa., mile 105.5	July	2	3.4	36	65	51		3.7
		August	1	2.9			121		4.4
Coxes Creek	Mouth, Rockwood, Pa., mile 104.5	July	1	5.2			43	1.2	3.8
		August	1	3.6		12	9		9
Casselman River, mile 85.5	Below Rockwood, Pa., mile 104	July	2	3.8	20	43	32		5.0
		August	1	2.9			119		5.4
	Mouth, Confluence, Pa., mile 87	July	2	3.9	15	28	22		1.2
		August	1	3.7			32		2.8
Youghiogheny River	Below Confluence, Pa., mile 84.5	July	2	5.4		8	6		1.1
		August	1	4.7			3		1.2
Dickerson Run	Upper edge, Vanderbilt, Pa., mile 53.5	October	1	4.6	38	80	56		8.0
West Branch Dickerson Run	do	December	1	5.6			22		4.4
Washington Run, mile 44	Below Star Junction, Pa., mile 49.5	August	1	4.8	3	34	30	2.8	6.6
Jacob Creek, mile 42	Below Scottdale, Pa., mile 53	September	1	5.4	2	20	18		4.6
Youghiogheny River	Above West Newton, Pa., mile 35	do	1	4.5	3	12	7		3.7
	Below West Newton, Pa., mile 33	do	1	4.5	4	10	10		3.3
Jacks Run	Above Greensburg, Pa., mile 58	do	1	2.7	4,990	8,720	8,420	2,247	2,406
		October	1	2.9	850	1,400	1,360	105	193
	Above mouth Slates Creek, Greensburg, Pa., mile 53.5	do	2	3.5	1,540	3,710	3,492	933	998
		November	5	4.2	795	1,966	1,772	608	648
		December	1	4.1	1,100	2,520	2,900	698	700
	Below mouth Slates Creek, mile 53	September	5	3.6	783	1,737	1,659	422	476
		October	1	3.3	580	1,220	1,010	131	166
	Above Youngwood, Pa., mile 52.5	September	1	6.0		143	168	56	63
	Below Youngwood, Pa., mile 51	do	1	6.0		151	163	55	62

[1] 1 sample.   [2] 3 samples.   [3] 2 samples.

TABLE Mo-7A.—*Monongahela River Basin: Laboratory data—Acid stream results*—Continued

Stream	Sampling point	Month, 1940	Number of samples	pH	Acidity, parts per million			Iron, parts per million	
					Methyl red	Phenolphthalein		Ferrous	Total
						Hot	Cold		
Sewickley Creek, mile 33.1	Above mouth Jacks Run, Youngwood, Pa., mile 51	September	2	3.5	190	385	344	56	143
Youghiogheny River, mile 15.6	Above Versailles, Pa., mile 20	do	1	3.8	19	37	30		6.2
	Below Versailles, Pa., mile 18	do	1	3.8	19	34	28		3.3
	Mouth, McKeesport, Pa., mile 15.6	August	2	3.5	35	73	55	[1]1.8	7
		September	3	3.8	22	40	31	[1].8	3.9
		October	4	3.6	45	76	66	24	[2]6.0
		November	2	4.5	8	24	20	[1]5.2	16
Brush Creek (Turtle Creek)	Above Irwin, Pa., mile 25	September	1	3.2	452	605	545	4.0	127
		October	1	3.3	245	359	312	1.6	75
		November	1	3.5	150	228	183	.4	51
	Below Irwin, Pa., mile 23	September	1	3.6	246	504	457	77	121
		October	1	3.4	261	488	438	72	118
		November	1	3.8	150	302	300	60	82
Turtle Creek, mile 11.0	Above Export, Pa., mile 28	September	1	2.8	1,120	1,550	1,360	93	182
		October	1	3.1	990	1,660	1,249	24	374
	Below Export, Pa., mile 25.5	September	1	2.9	650	890	840	15	99
		October	1	3.1	650	1,350	839	8	175
	Above Trafford, Pa., mile 18.5	September	1	3.9	139	179	159		9
		October	1	3.2	213	300	248		24
	Below Trafford, Pa., mile 17.5	September	1	3.3	98	142	135	7	12
		October	1	3.5	151	235	194	5	16
	Above Pitcairn, Pa., mile 16	September	1	3.3	239	313	294	5.5	40
		October	1	3.2	365	623	498	85	130
	Above Turtle Creek, Pa., mile 14.5	September	1	2.9	186	247	233	6.5	36
		October	1	2.9	300	422	367	28	70
	Below Turtle Creek, Pa., mile 12	September	1	2.9	157	234	223	13	37
		October	1	3.2	220	365	318	54	72
Monongahela River	Lock and dam No. 2, mile 11.2	August	2	3.6	34	65	49		2.7
		September	3	3.9	15	29	25		4.3
		October	4	3.7	26	43	33	[1].8	5
		November	3	4.3	13	27	21		5.6
	Mouth, mile 0.05	September	2	4.4	8	22	22	[1]2.1	4.2
		October	4	4.0	18	35	30	[1]3.5	3.7
		November	2	3.6	17	34	31	[1]5.8	5.0

[1] 1 sample.
[2] 3 samples.
[3] 2 samples.

BEAVER RIVER BASIN

CONTENTS

	Page
Contents	409
Syllabus and conclusions	411
Description	413
Presentation of field data	414
Presentation of laboratory data	417
Hydrometric data	421
Discussion	424

LIST OF TABLES

B-1.—Cost estimates of remedial measures	412
B-2.—Surface water supplies	414
B-3.—Sources of pollution	415
B-4.—Industrial wastes	417
B-5.—Selected laboratory results	418
B-5a.—Laboratory results of taste and odor survey	419
B-6.—Monthly mean summer flows	421
B-7.—Summary of laboratory data	427

LIST OF FIGURES

B-1.—Map—Sources of pollution	411
B-2.—Chart—Sources of pollution and selected laboratory data	416
B-3.—Map—Coliform results	420
B-4.—Map—Dissolved oxygen results	420
B-5.—Map—Biochemical oxygen demand results	420
B-6.—Chart—Summer low-flow frequency curve	422

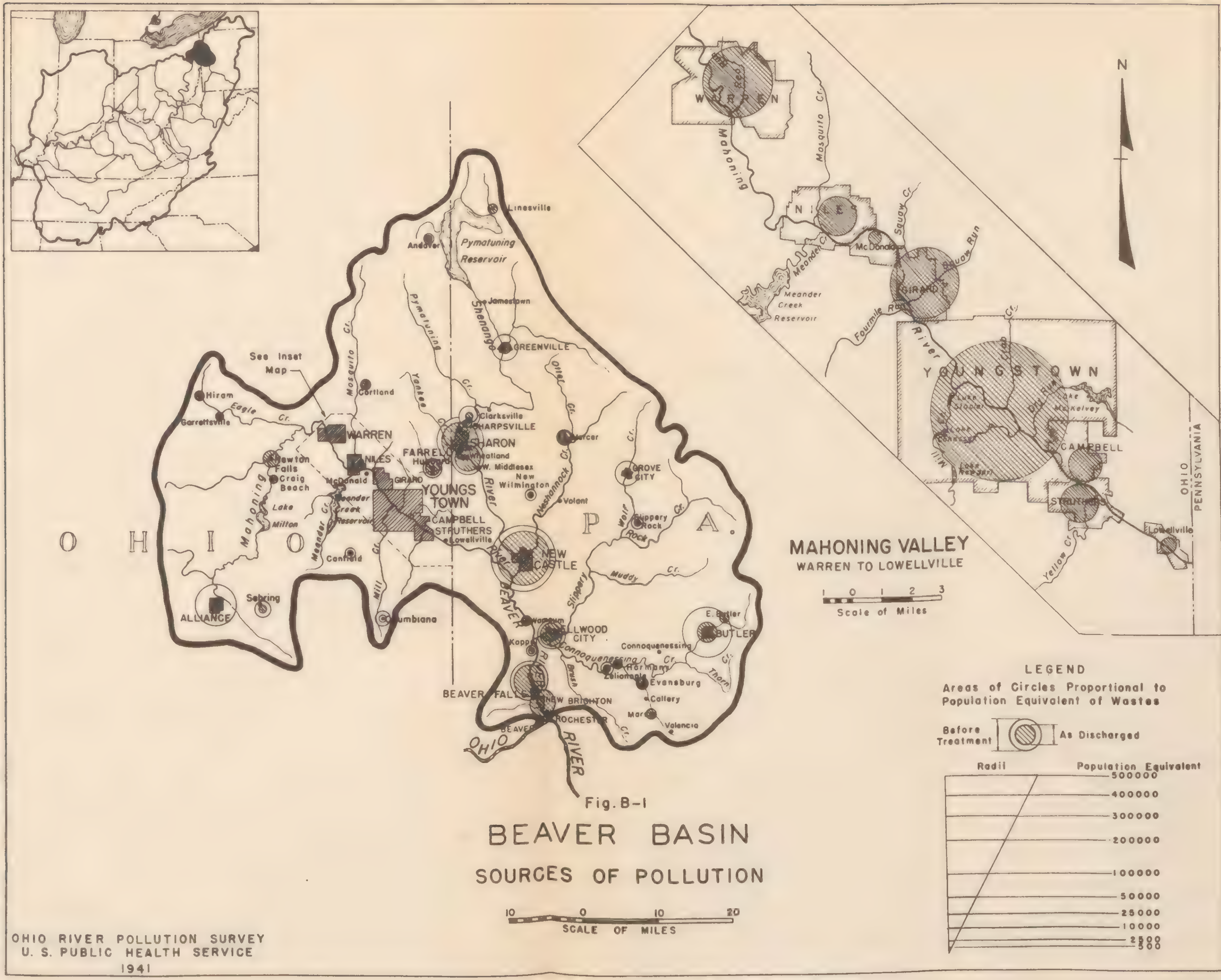


Fig. B-1

BEAVER BASIN

SOURCES OF POLLUTION

Fig. B-1

(Face p. 411)

GPO-43 O-9035

BEAVER RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Beaver River drains 3,145 square miles in Ohio and Pennsylvania. The population of the area is 728,000, roughly 230 per square mile, of which almost two-thirds are in urban communities. The largest city, Youngstown, Ohio (167,720), is the center of the third largest steel-producing area in the country. The streams and reservoirs of the basin are intensively used as sources of municipal and industrial water supply and for recreation. About 42 percent of the sewage is treated and more than 95 percent of the untreated wastes enter the Mahoning River in the Youngstown district (Warren to Lowellville). Except for the Beaver and sections of the Mahoning and Shenango Rivers, the streams of the basin are relatively clean. Abatement of pollution in the Youngstown district can be most economically effected by a combination of waste treatment and streamflow regulation. Reservoir sites have been investigated by the United States Engineer Department with a view toward providing needed additional flow for both pollution abatement and industrial water supply. Further industrial development in the Youngstown district should be predicated on obtaining additional water from sources not now considered.

CONCLUSIONS

(1) Eighteen of the fifty public water supplies in the basin are from surface sources. Twelve of these, serving 430,000 people are from streams or reservoirs subject to pollution.

(2) Sewage from 515,000 people, industrial wastes equivalent to sewage from an additional 165,000 people and about 32 tons of acid per day enter the streams of the basin. Thirty-six plants treat about 42 percent of the sewage and several of the industrial plants have installed waste treatment facilities.

(3) Laboratory data show the Mahoning River, particularly in the Youngstown district, to be grossly polluted. The Beaver River is moderately polluted and the Shenango is in fairly satisfactory sanitary condition. Smaller tributary streams are relatively clean.

(4) The major pollution problem of the basin is in the Youngstown district. More than 95 percent of the untreated wastes in the entire basin enter the Mahoning River in the 25 miles from Warren to Lowellville.

(5) Industrial water use in this stretch, principally for cooling purposes, is about 20 times the minimum stream flow. The resulting high-water temperatures intensify the effects of pollution and increase industrial costs.

(6) Chemical treatment of sewage plus low-flow control by reservoirs offers the most economical method of organic pollution abatement in the Youngstown district. Low-flow augmentation alone, or without a parallel program of sewage treatment, will actually have a detrimental effect on the Beaver River because of decreased time of flow. Local conditions and river temperature will, of course, be improved.

(7) Primary treatment, the minimum that can be considered satisfactory under the most favorable circumstances, is indicated at four other communities where stream flows are adequate including Newton Falls, Ohio, and New Brighton, Pa. The latter city, being near the mouth, is primarily an Ohio River problem. Secondary treatment is indicated at five small towns in Ohio located on streams subject to very low flows. Additions or improvements to treatment facilities are needed at eight places and progress is being made toward completion of the improvements in most of these cases.

(8) Industrial treatment is needed principally to reduce phenol discharges at byproduct coke plants and to reduce the acid load on the stream. This can be accomplished by methods now in use at other plants.

(9) A summary of cost estimates of remedial measures from table B–1 follows:

Treatment	Capital cost	Annual charges
Existing	$4,760,000	$415,000
Suggested additional	6,000,000	865,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	$5,830,000	$845,000
Secondary, all places	10,680,000	1,265,000

TABLE B–1.—*Beaver River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	17	18	218,400	$4,760,000	$300,000	$115,000	$415,000
Suggested minimum correction:							
Sewage treatment plants	14	5	297,100	2,970,000	210,000	190,000	400,000
Required interceptors				1,990,000	95,000		95,000
Independent industrial waste correction				1,040,000	135,000	235,000	370,000
Total				6,000 000	440,000	425,000	865,000
Comparative cost:							
Primary treatment all waste				5,830,000	425,000	420,000	845,000
Secondary treatment all waste				10,680,000	710,000	555,000	1,265,000
As suggested				6,000,000	440,000	425,000	865,000

Description

The Beaver River is formed by the confluence of the Mahoning and Shenango Rivers near New Castle, Pa., and flows southward for 20 miles to its junction with the Ohio River 25 miles below Pittsburgh. It drains an area of 3,145 square miles, of which 1,360 are in Ohio and 1,785 in Pennsylvania. Much of the land is flat, particularly in the northern half of the basin but the southeastern portion is quite hilly. The principal tributaries of the Beaver River are:

Tributary	Distance above mouth of Beaver	Drainage area, square miles
Connoquenessing Creek	12.4	830
Mahoning River	20.7	1,100
Shenango River	20.7	1,080

The basin is densely populated (230 per square mile) and about two-thirds of the population is in the 22 urban communities. The populations of some of the larger cities and of the basin as a whole are shown below:

	Population			
	1910	1920	1930	1940
Principal cities:				
Youngstown, Ohio	79,066	132,358	169,912	167,720
New Castle, Pa	36,280	44,938	48,674	47,638
Warren, Ohio	11,081	27,050	41,062	42,837
Sharon, Pa	15,270	21,747	25,908	25,622
Butler, Pa	20,728	23,778	23,568	24,477
Alliance, Ohio	15,083	21,603	23,047	22,405
Beaver Falls, Pa	12,191	12,802	17,147	17,098
Niles, Ohio	8,361	13,080	16,314	16,273
Farrell, Pa	10,190	15,586	14,359	13,899
Campbell, Ohio	4,972	11,237	14,673	13,785
Ellwood City, Pa	3,902	8,958	12,323	12,329
Struthers, Ohio	3,370	5,847	11,249	11,739
Entire basin:				
Rural	178,013	189,950	220,208	251,101
Urban	251,086	389,343	480,079	477,267
Total	429,099	589,293	700,287	728,368

Almost all of the cities experienced a period of rapid population increase during the first 30 years of this century which saw the region develop into a major center of steel production.

This period of rapid growth ended in 1930 and most of the cities lost population during the next 10 years. The rural population continued to increase, however.

Water uses.—None of the streams are navigable at present except for the lower mile of the Beaver which is affected by backwater from the Ohio River. A proposal to connect the Ohio River and Lake Erie by a canal using the Beaver, Mahoning, and Grand Rivers has been studied by the United States Engineer Department and considered by the Congress a number of times but has not been authorized.

There are no hydroelectric power storage reservoirs and no sites where the development of hydroelectric energy appears to be economically feasible at the present time. No flood-control reservoirs, as such, have been built but a number of reservoirs built for other purposes have undoubtedly aided in reducing flood heights. The largest of these are the Pymatuning Reservoir, Lake Milton, and Meander Reservoir. Pymatuning Reservoir on the upper Shenango has a capacity of 192,000 acre-feet and a surface area of 17,880 acres. It was built by Pennsylvania primarily to regulate stream flow to insure an adequate supply of water for downstream cities and industries. Lake Milton on the Mahoning River above Warren was built by the city of Youngstown and private interests to increase the flow of the stream during dry weather. It has been useful in this respect but its small capacity of 28,100 acre-feet has limited its utility. Both Pymatuning Reservoir and Lake Milton are used extensively for recreation. Meander Reservoir on Meander Creek was built by the Mahoning Valley Sanitary District to provide public water supplies for Youngstown and Niles. Its capacity is 32,400 acre-feet. Fifteen other reservoirs with capacities of from 100 to 4,600 acre-feet have been built for water supply, recreation, or flow regulation.

The Berlin Reservoir on the Mahoning above Lake Milton is now (1942) under construction by the United States Engineer Department in connection with the authorized program for Ohio River flood control. In addition to controlling floods, the reservoir will provide storage for low-flow control.

Presentation of Field Data

Figure B–1 shows the location and magnitude of the more important sources of pollution in the basin. Figure B–2 shows similar data and, in addition, the location of public water supply intakes from polluted streams and selected laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Fifty public water supplies in the basin served 554,100 people. Eighteen supplies serving almost 500,000 people are from surface sources and 12 of these are from streams or reservoirs subject to sewage pollution. Table B–2 shows data on the surface water supplies of the basin. The supplies from the Beaver River are the most seriously polluted and the most complete treatment of these supplies often fails to produce a palatable water.

Table B–2.—*Beaver River Basin: Surface water supplies*

Municipality	State	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
New Brighton	Pennsylvania	Beaver River	3.6	FD	22,500	1.75
Beaver Falls	do	do	5.3	FD	25,000	2.30
West Pittsburgh	do	do	18.0	FD	400	.07
New Castle	do	Shenango River	25.8	FD	58,000	4.25
Sharon	do	do	47.5	FD	50,000	3.80
Warren	Ohio	Mahoning River	56.5	LD	42,800	3.98
Alliance	do	do	101	FD	22,400	3.50
Sebring	do	do	105	FD	3,900	.50

[1] Miles above mouth of Beaver River.
[2] L=Lime-soda softened; D=Chlorinated; F=Coagulated, settled, filtered.

TABLE B-2.—*Beaver River Basin: Surface water supplies*—Continued

Municipality	State	Source	Mile	Treatment	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
Ellwood City	Pennsylvania	Slippery Rock Creek	21.5	FD	12,000	2.00
Mercer	do	Otter Creek	48.5	FD	2,200	.12
Youngstown	Ohio	Meander Creek Reservoir.	52.5	LD	175,000	10.70
Niles	do	do	52.5	LD	16,200	2.60
	Other surface supplies					
Zelionople	Pennsylvania	Impounded, Scholar Run.		FD	2,000	0.18
Evansburg	do	Wells, Likens Run		F	1,600	.12
Butler	do	Connoquenessing Creek.	61	FD	30,000	3.30
Greenville	do	Impounded, tributary of Little Shenango.		FD	8,500	.50
Struthers	Ohio	Impounded, Yellow Creek.		FD	13,000	.65
Campbell	do	do		FD	13,700	.56
Total:						
Below sewer outfalls					430,400	35.57
Other					68,800	5.31
Total surface water supplies					499,200	40.88

Sewerage.—Sewage from 515,700 people is discharged to the streams of the Beaver Basin. About 42 percent of this waste is treated. In the Pennsylvania section of the basin practically all sewage is treated, the principal exception, New Brighton, discharging only about 1 mile from the mouth and being primarily an Ohio River problem. On the other hand, in the Ohio section of the basin, 285,800 out of 321,500 discharge sewage without treatment. Almost all of this waste enters the Mahoning River in the 25-mile stretch from Warren to Lowellville.

There are 35 sewage-treatment plants in the basin, 17 of which provide primary treatment and 18 of which provide secondary treatment. Twenty-six of the plants are in Pennsylvania and only nine are in Ohio.

TABLE B-3.—*Beaver River Basin: Source of significant pollution, including industrial wastes, expressed as sewered population equivalent* (*biochemical oxygen demand*)

Municipality	State	Receiving stream	Mile[1]	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
New Brighton	Pennsylvania.	Beaver River	3	9,000	None	9,000	9,000
Beaver Falls	do	do	4	19,000	Primary	19,000	12,400
Farrell	do	Shenango River	44	14,000	do	14,000	9,100
Sharon	do	do	45	27,000	do	27,000	17,500
Sharpsville	do	do	49	5,000	Secondary	5,000	700
Greenville	do	do	69	8,500	Primary	8,700	5,600

[1] Miles above mouth of Beaver River.

TABLE B-3.—*Beaver River Basin: Source of significant pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*—Continued

Municipality	State	Receiving stream	Mile	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
New Castle	Pennsylvania	Mahoning River	22	50,000	Primary; chlorination.	57,500	37,500
Struthers	Ohio	do	34	11,700	None	11,700	11,700
Poland C. S. D.[2]	do	do	35	4,000	do	4,000	4,000
Campbell	do	do	36	13,700	do	13,700	13,700
Youngstown	do	do	40	178,700	do	260,500	260,500
Girard	do	do	44	9,700	do	64,700	64,700
Niles	do	do	50	16,200	do	16,200	16,200
Warren	do	do	56	42,800	do	56,800	56,800
Newton Falls	do	do	76	3,100	do	3,100	3,100
Alliance	do	do	101	22,000	Secondary	22,000	2,200
Ellwood City	Pennsylvania.	Connoquenessing Creek.	14	10,500	Primary chlorination.	10,500	6,800
Butler	do	do	57	27,000	Secondary	31,100	4,700
Grove City	do	Wolf Creek	41	7,000	do	7,000	1,000
Mercer	do	Neshannock Creek.	48	2,500	Primary	2,500	1,600
Hubbard	Ohio	Little Yankee Creek.	48	4,100	do	4,100	2,700
Sebring	do	Fish Creek	107	3,500	Secondary.	3,500	500
33 smaller sources				26,700	(3)	28,500	16,400
Total:							
Ohio				321,500		472,800	444,300
Pennsylvania				194,200		207,300	114,100
Total				515,700		680,100	558,400

[2] County sewer district.
[3] 10 primary and 11 secondary treatment plants.

Industrial wastes.—Table B-4 summarizes data on the sources of industrial wastes by type of industry and method of disposal. The population equivalent of these wastes does not reflect the magnitude of the industrial-waste problem since the steel-mill wastes have no significant biochemical oxygen demand. The disposal of waste pickle liquor from steel mills in the basin is summarized as follows:

Free acid [1] in waste pickle liquor

[Pounds per day]

State	Total	Neutralized	Discharged without neutralization
Ohio	63,000	3,000	60,000
Pennsulyania	18,600	14,800	3,800
Total	81,600	17,800	63,800

[1] Exclusive of $FeSO_4$ which exerts some acid effect.

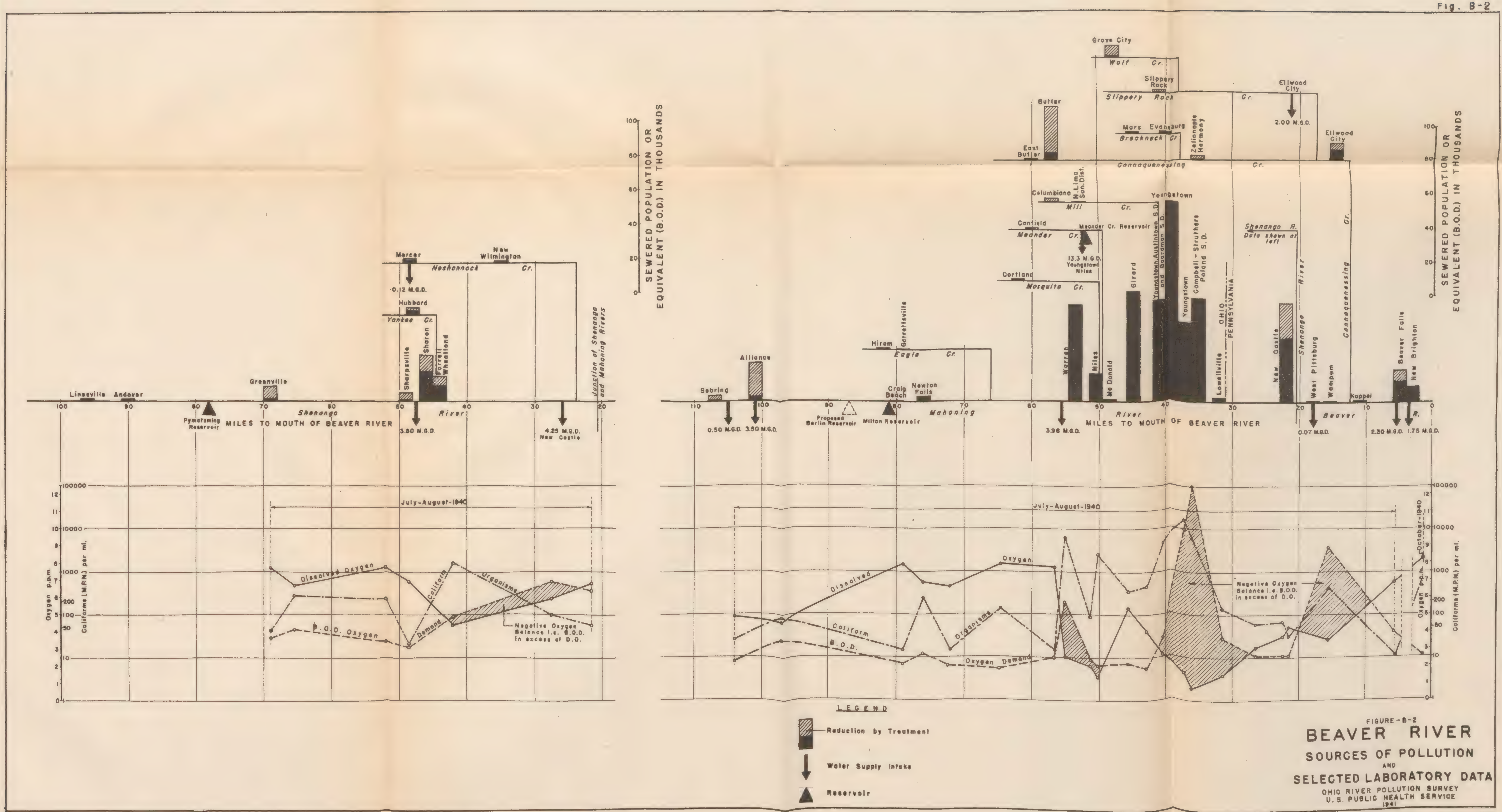


FIGURE - B-2
BEAVER RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

GPO-43 O-90035

TABLE B-4.—*Beaver River Basin; Summary of industrial wastes not discharged to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Brewing	2	1	1	2	5,300
Byproduct coke	4		4	3	80,400
Chemical	4	1	3	2	
Meat	2	2		2	7,200
Milk	3	1	2	2	3,400
Steel mill	39	1	38	24	
Miscellaneous	22	3	19	10	56,300
Waste unconnected to municipal treatment	76	9	67	45	152,600
Waste connected to municipal treatment					11,800
Total industrial waste in basin					164,400

As in the case of domestic sewage, the bulk of the organic industrial wastes and of the acid is discharged to the Mahoning River in the Youngstown area.

Industrial water supply.—About 780 million gallons per day of water are used by the various industries in the basin and about 630 million gallons per day of this are drawn from the Mahoning River in the 25-mile stretch from Warren to Lowellville. Relatively small amounts of this industrial water supply are used as boiler feed and in manufacturing processes. Almost all of it is used as cooling water and is returned to the streams unchanged except for its increased temperature. Since this water demand exceeds even the average flow of the stream, the water must be reused and the temperature increases tend to pyramid. During periods of low stream flow the water temperature below Youngstown has risen often to over 110° F.

PRESENTATION OF LABORATORY DATA

Table B-7 (p. 427) summarizes laboratory data on the Beaver River. Table B-5 shows selected data at some of the more important points. Except for the observations at the mouth of the Beaver, all the results were obtained by a mobile laboratory during June, July, and August, 1940. The mouth of the Beaver was sampled in October, November, and December, 1940 by the laboratory boat *Kiski*.

In cooperation with the State health departments of Ohio and Pennsylvania, taste and odor problems in the Beaver Basin were studied in November and December 1940 and January 1941. Laboratory facilities at Mineral Ridge, Ohio, were made available through the courtesy of the Mahoning Valley sanitary district. Results of this work are summarized in table B-5A.

TABLE B–5.—*Beaver River Basin; Selected laboratory data*

River	Mahoning	Mahoning	Mahoning	Mahoning	Mahoning	Mahoning	Mahoning
Location	Above Alliance	Below Alliance	Waterworks, Warren	Below Warren	Above Niles	McD. via Niles	Libert St., Girard
River miles above— Confluence with Shenango	83	76	35.5	34	30.2	29.2	24.8
Mouth of Beaver	104	97	56.5	55	51.2	50.2	45.8
Period, 1940	July	July	July–August	July–August	July–August	July–August	July
Number of samples	2	2	5	5	5	5	4
Flow in cubic feet per second, sampling days	4	20	235	237	243	290	355
Water temperature, °C	26.5	26.0	23.9	25.8	25.4	24.6	24.1
Coliforms per milliliter	25	83	16	7,100	86	2,400	341
Dissolved oxygen, parts per million	4.8	4.5	7.7	2.5	2.0	1.4	5.3
Biochemical oxygen demand, 5-day, parts per million	2.2	3.4	2.6	5.7	2.4	2.0	2.2

River	Mahoning	Mahoning	Mahoning	Mahoning	Mahoning	Mahoning	Mahoning
Location	Division St., Youngstown	Center St., Youngstown	Sheet & Tube, Campbell	Bridge, Lowellville	Bridge, Edinburg	Bridge, Mahoning town	Near Mouth
River miles above: Confluence with Shenango	22	16	15	10.5	5.5	1.5	0.5
Mouth of Beaver	43	37	36	31.5	26.5	22.5	21.5
Period, 1940	July–August	July–August	July–August	July–August	July–August	July–August	July–August
Number of samples	8	8	8	8	8	7	4
Flow in cubic feet per second, sampling days	294	260	280	291	307	367	214
Water temperature, °C	27.2	29.6	30.0	29.2	26.1	25.9	23.9
Coliforms per milliliter	450	11,400	6,100	186	62	71	31
Dissolved oxygen, parts per million	4.0	1.6	0.7	1.6	3.1	3.7	4.3
Biochemical oxygen demand, 5-day, parts per million	1.8	10.0	12.4	3.7	2.6	2.6	2.6

River	Shenango	Shenango	Shenango	Shenango	Shenango	Shenango	Shenango
Location	Riverside Hotel, Greenville	Below Greenville	Mercer St., Sharpsville	Clark St., Sharpsville	Below Sharon-Farrell	Above New Castle	Below New Castle
River miles above: Confluence with Mahoning	48	46.5	31	29.3	21	6.5	0.5
Mouth of Beaver	69	65.5	52	50.3	42	27.5	21.5
Period, 1940	July–August	July–August	July–August	July–August	July–August	July–August	July–August
Number of samples	5	5	5	5	5	6	5
Flow in cubic feet per second, sampling days	122	133	226	262	268	274	325
Water temperature, °C	20.8	21.3	22.4	22.6	23.7	22.7	21.4
Coliforms per milliliter	41	280	233	22	1,800	98	58
Dissolved oxygen, parts per million	7.6	6.6	7.8	6.9	4.4	5.9	6.8
Biochemical oxygen demand, 5-day, parts per million	3.6	4.1	3.4	3.3	5.0	6.9	6.4

River	Beaver	Beaver	Beaver	Neshan Creek	Connoquenessing Creek	Connoquenessing Creek	Connoquenessing Creek
Location	Below New Castle	Eastvale, Beaver Falls	Near mouth	Below Mercer	At Butler	Below Butler	At Renfrew
River miles above mouth of Beaver.	15.5	5.5	1.4	46.5	57.5	54.0	49
Period, 1940	July–August	July–August	October	August	July	July	July
Number of samples	6	6	11	2	2	2	2
Flow in cubic feet per second, sampling days	502	750	633	11	10	20	30
Water temperature, °C	24	23.8	15.2	20.2	24.5	26.0	25.5
Coliforms per milliliter	437	10	802	330	5	13	58
Dissolved oxygen, parts per million	3.5	6.8	8.3	5.0	5.0	3.4	6.6
Biochemical oxygen demand, 5-day, parts per million	8.8	4.0	2.6	2.3	1.1	6.1	3.6

TABLE B-5A.—*Beaver River Basin: Laboratory results of taste and odor survey of Mahoning and Beaver Rivers from Warren, Ohio, to mouth*

River	Location of sampling point	River mile [1]	Number of samples	Temperature °C.	Phenol—parts per billion			Threshold odor value			pH	Iron—parts per million
					Maximum	Minimum	Average	Maximum	Minimum	Average		
Period of self-purification (Nov. 7-Dec. 3, 1940)—Average discharge Beaver River at Beaver Falls 2,036 cubic feet per second												
Mahoning	Above Warren	64.5	10	3.9	2	0	0.2	16	2	6	7.4	2.8
Do	Above Niles	51.2	4	4.0	250	80	156	16	8	10	6.5	27
Do	Below Niles	50.2	10	6.3	220	70	141	16	4	8	6.3	17
Do	Youngstown:											
	Division St	43.0	10	7.6	140	2	87	16	4	8	6.4	11
	Mahoning Ave	40.3	10	12.2	320	5	164	32	4	13	6.6	6.4
	Center St	37.0	5	10.8	240	20	130	16	4	11	6.6	16
Do	Campbell at Youngstown Sheet and Tube Bridge	36.0	10	14.2	1,600	30	777	256	16	80	6.3	18
Do	Struthers Bridge	34.6	0									
Do	Lowellville Bridge	31.5	8	15.2	1,000	38	502	64	8	29	6.2	19
Do	Mount Jackson Highway Bridge	22.5	8	7.8	800	10	156	32	8	15	7.1	1.3
Shenango	New Castle Viaduct	23.0	8	5.2	0	0	0	16	2	6	6.9	5.5
Beaver	Above Beaver Falls	5.5	8	4.1	2	0	.2	8	2	4	6.7	5.3
Period of phenolic contamination (Dec. 4, 1940-Jan. 10, 1941)—Average discharge Beaver River at Beaver Falls, 6,330 cubic feet per second												
Mahoning	Above Warren	64.5	13	2.1	2	0	0.15	8	2	3	7.0	1.1
Do	Above Niles	51.2	13	4.0	600	0	141	16	2	8	6.4	18
Do	Below Niles	50.2	13	3.6	180	0	83	16	2	6	6.4	12
Do	Youngstown:											
	Division St	43.0	13	4.3	120	0	61	8	2	5	6.4	13
	Mahoning Ave	40.3	13	5.6	800	10	223	8	4	6	6.4	13
	Center St	37.0	13	6.9	400	30	159	64	4	27	6.5	11
Do	Campbell at Youngstown Sheet and Tube Bridge	36.0	13	7.4	1,000	60	570	128	16	41	6.4	13
Do	Struthers Bridge	34.6	10	8.5	2,000	90	929	256	16	59	6.5	16
Do	Lowellville Bridge	31.5	11	8.0	1,800	160	824	128	16	41	6.5	13
Do	Mount Jackson Highway Bridge	22.5	11	8.3	1,800	50	685	128	8	29	6.6	9
Shenango	New Castle Viaduct	23.0	10	3.9	15	0	3.5	8	0	3	6.8	2.4
Beaver	Above Beaver Falls	5.5	11	4.8	230	35	108	64	2	11	6.7	2.3

[1] Miles above mouth of Beaver River.

Figures B-3, B-4, and B-5 show graphically the coliform, dissolved oxygen, and biochemical oxygen demand results. These results represent the most unfavorable monthly averages.

The laboratory data indicate clearly the grossly polluted condition of the Mahoning River in its lower 25 miles. The Beaver River is also polluted and the Shenango is in somewhat better sanitary condition. Considering the high degree of industrial development, the large urban population, and the low stream flows, the situation might well be worse.

With the exception of the small community of Linesville (which has passed a bond issue for sewage treatment), all of the towns in the Shenango Valley have sewage treatment. The most unfavorable results in this valley were obtained below Sharon where about half of the sewage was being bypassed at the time samples were collected during remodeling activities at the sewage treatment plant. The area flooded by Pymatuning Reservoir was formerly a large swamp and the unstable organic matter in the swamp imparts an appreciable biochemical oxygen demand to the impounded water.

In the Mahoning Valley, the addition of iron coagulants in the form of waste pickle liquors probably tends to coagulate and settle pollution in the river. In addition, multiple industrial reuse of the river water, causing higher water temperatures and increased time of flow, affords excellent conditions for self-purification. During periods of increased flow and lower temperature, much higher coliform counts and somewhat higher biochemical oxygen demands than those observed would probably be found in the Mahoning and the Beaver. In fact, some of the highest coliform counts were the fall and winter observations made at the mouth of the Beaver.

In spite of the amount of pickle liquor discharged in the district, very few pH values found in the district were below 6.0. Only two pH values below 6.0 were observed in the June, July, August period of observation and two more below 6.0 were observed in the November, December, January period when the taste and odor study was being made. In all cases these pH values were well above 5.0.

Hardness in streams of the Shenango Basin and in the eastern tributaries of the Beaver was generally of the order of magnitude of 100 parts per million. In the Mahoning Valley hardness values up to 350 parts per million were observed.

Taste and odor survey.—The data (table B-5A) have been divided into two sections on the basis of the appearance of phenol in the Beaver at Beaver Falls. During the first period, phenol was present in the Mahoning River in the Youngstown area but self-purification had removed this pollution before the stream reached Beaver Falls. During the second period, due to lower temperatures and shorter times of flow, self-purification failed to remove the phenol from the river before it reached Beaver Falls, where it caused great difficulty in the production of a palatable water.

The laboratory determinations show that large quantities of phenol were entering the Mahoning River in four different sections where byproduct coke plants are located.

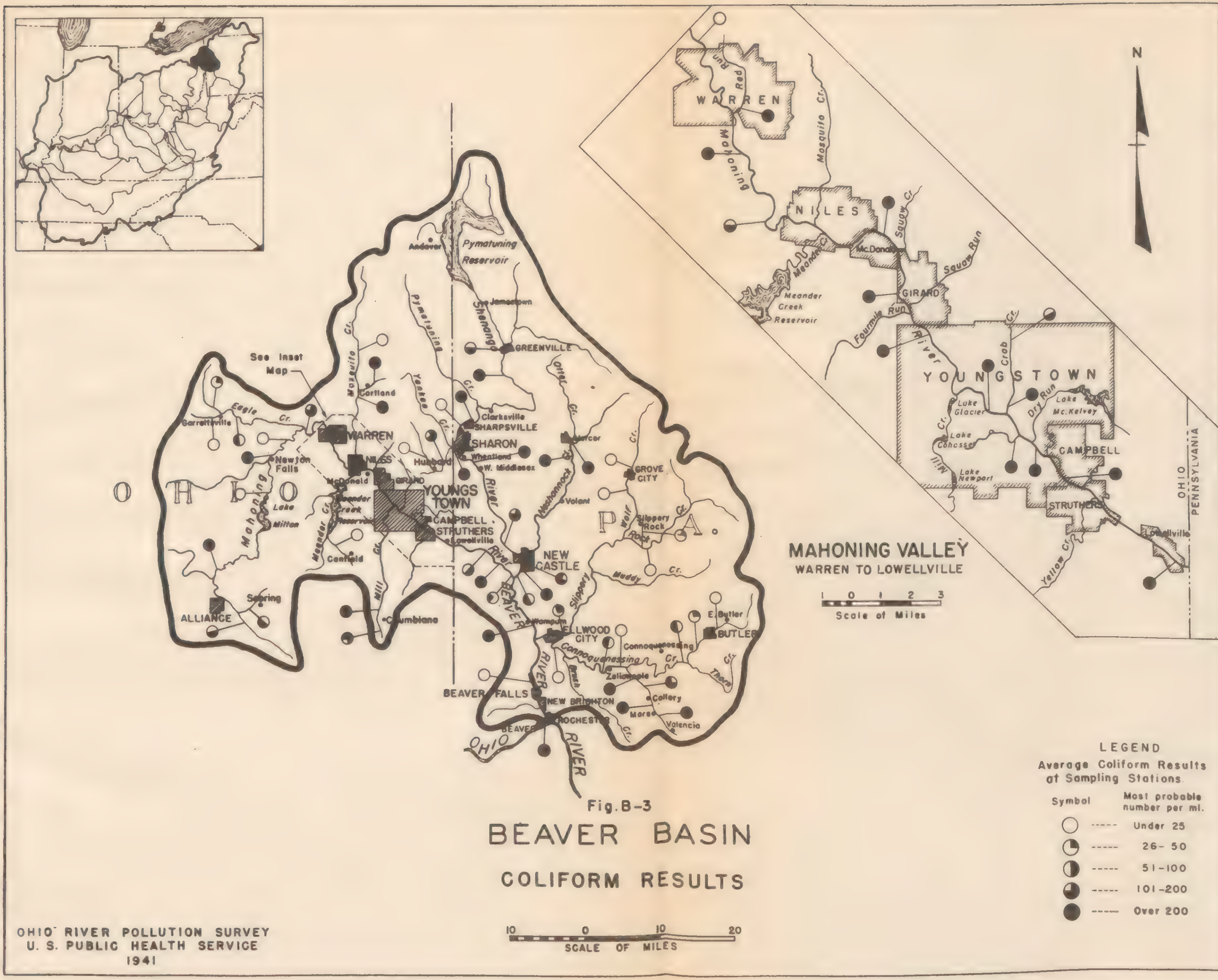


Fig. B-3
BEAVER BASIN
COLIFORM RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. B-3

(Face p. 420) No. 1

GPO-43 D-9035

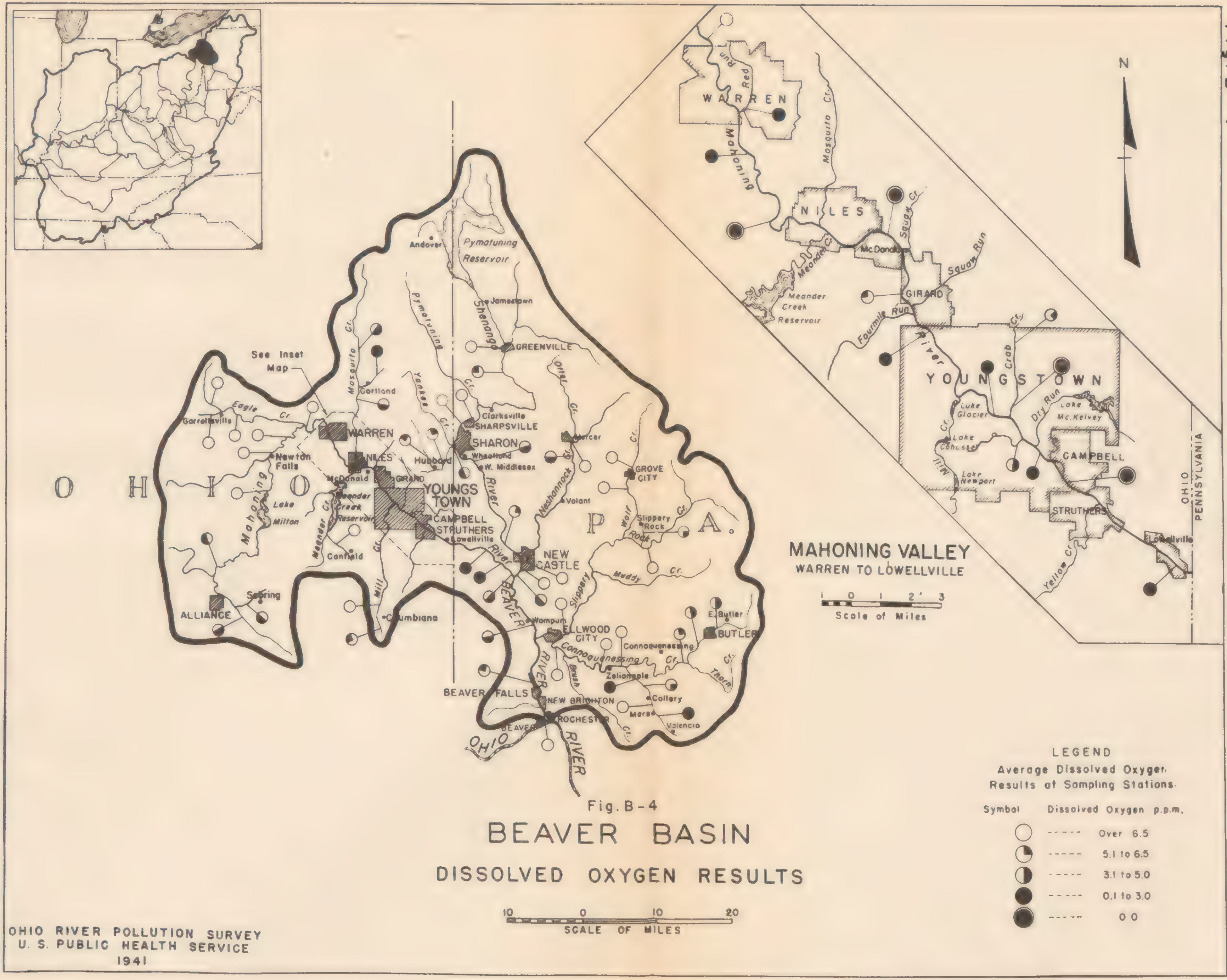


Fig. B-4

BEAVER BASIN

DISSOLVED OXYGEN RESULTS

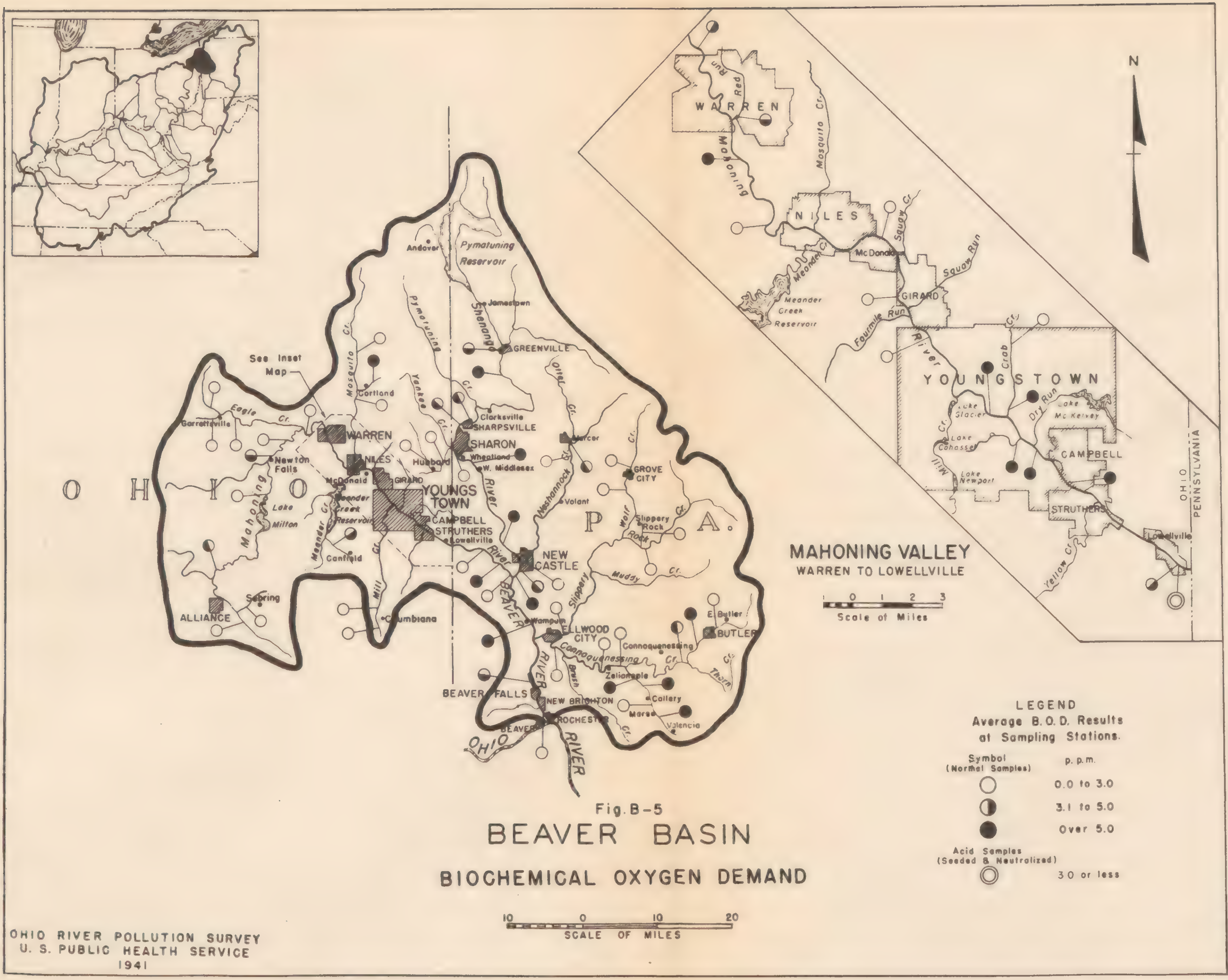


Fig. B-5

BEAVER BASIN

BIOCHEMICAL OXYGEN DEMAND

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 420) No. 8 GPO-43 O-9035

Fig. B-5

HYDROMETRIC DATA

Twenty-one stream gaging stations have been maintained in the Beaver River Basin at various times and 14 are currently in operation. Table B–6 shows monthly mean summer flows at 8 stations for the 3 driest summers of record. Stream flow at Sharon and Wampum have been affected by the Pymatuning Reservoir since 1933 so the records shown in table B–6 for these stations do not represent conditions likely to recur. Figure B–6 shows the effect of the reservoir on the flow at Sharon. It also shows the flow in the Mahoning at Youngstown based on 18 years of record and the flow as it would be regulated by the proposed Berlin Reservoir. Figure B–6 indicates that the frequency with which minimum monthly mean summer flows have occurred is as follows:

Location	Minimum monthly mean summer flows in cubic feet per second that may be expected once in—			
	2 years	5 years	10 years	Minimum
Mahoning at Youngstown	133	94	75	47
Mahoning at Youngstown (regulated by Berlin Reservoir)	183	165	162	160
Shenango at Sharon (unregulated at Pymatuning)	54	33	21	7

TABLE B–6.—*Beaver River Basin—Monthly mean summer flows for years in which low summer flows have occurred*

River	Mahoning	Mahoning	Shenango	Shenango
Location	Warren, Ohio	Youngstown, Ohio	Sharon, Pa.	New Castle, Pa.
River miles above mouth of Beaver	56.5	41.8	45.5	24.3
Drainage area (square miles)	599	899	608	792
Period of record	1924–35	1921–39	1909–38	1910–34
Year	1930	1930	1916	1933
June, cubic feet per second	124	177	128	207
July, do	80	104	18	40
August, do	35	47	7	18
September, do	37	56	9	26
Year	1934	1934	1930	1930
June, cubic feet per second	44	66	99	142
July, do	43	66	53	67
August, do	83	198	14	25
September, do	195	274	18	30
Year	1933	1933	1932	1923
June, cubic feet per second	179	280	70	102
July, do	59	82	120	31
August, do	55	86	27	26
September, do	44	71	17	36

Fig. B-6

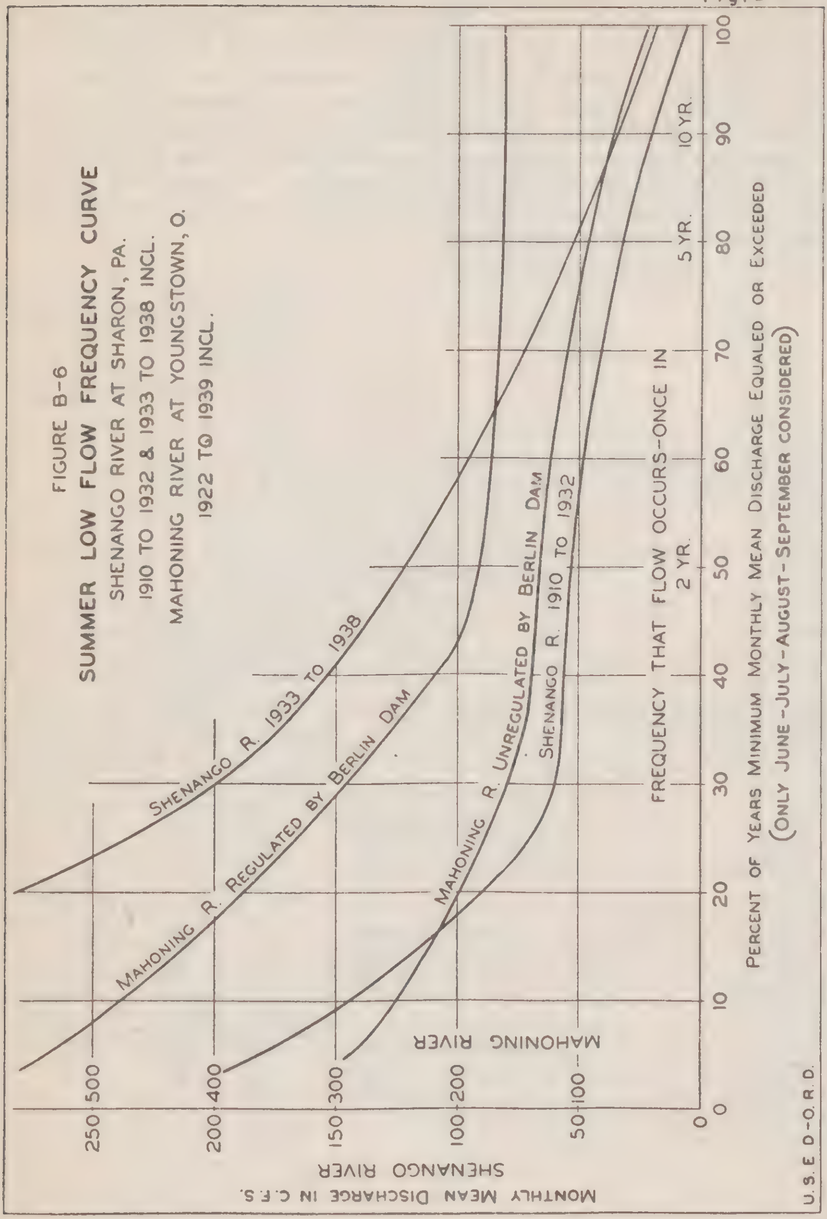


FIGURE B-6
SUMMER LOW FLOW FREQUENCY CURVE
SHENANGO RIVER AT SHARON, PA.
1910 TO 1932 & 1933 TO 1938 INCL.
MAHONING RIVER AT YOUNGSTOWN, O.
1922 TO 1939 INCL.
SHENANGO R. 1933 TO 1938
MAHONING R. REGULATED BY BERLIN DAM
MAHONING R. UNREGULATED BY BERLIN DAM
SHENANGO R. 1910 TO 1932
FREQUENCY THAT FLOW OCCURS-ONCE IN
2 YR.
5 YR.
10 YR.
PERCENT OF YEARS MINIMUM MONTHLY MEAN DISCHARGE EQUALED OR EXCEEDED
(ONLY JUNE-JULY-AUGUST-SEPTEMBER CONSIDERED)
0 10 20 30 40 50 60 70 80 90 100
MONTHLY MEAN DISCHARGE IN C.F.S.
SHENANGO RIVER
0 50 100 150 200 250
MAHONING RIVER
0 100 200 300 400 500
U.S.E D-O.R.D.

TABLE B-6.—*Beaver River Basin—Monthly mean summer flows for years in which low summer flows have occurred*—Continued

River	Beaver	Mosquito Creek	Connoquenessing Creek	Slippery Rock Creek
Location	Wampum, Pa.	Niles, Ohio	Hazen Pa.	Wurtemburg, Pa.
River miles above mouth of Beaver	15.4	51	23	18.5
Drainage area, square miles	2,235	139	356	406
Period of record	1914–18 1933–39	1929–39	1920–39	1912–39
Year	1916	1933	1930	1930
June, cubic feet per second	1,884	11.5	254	233
July, do	559	2.3	26	66
August, do	167	.1	11	35
September, do	153	.2	11	40
Year	1933	1934	1939	1914
June, cubic feet per second	720	0.3	290	184
July, do	203	.2	139	67
August, do	156	23.6	54	38
September, do	157	6.1	17	48
Year	1934	1930	1923	1932
June, cubic feet per second	222	6.2	234	84
July, do	201	1.4	40	127
August, do	970	.2	20	49
September, do	578	.2	21	42

Proposed stream control.—The Corps of Engineers has determined four sites to be most nearly satisfactory for flood-control and allied reservoir development in connection with the program for Ohio River flood control as follows:

Reservoir	Stream	River-miles above mouth of Beaver River	Storage	Supplemental flow made available	Approximate minimum regulated summer discharge at project sites
			Acre-feet	*Cubic feet per second*	*Cubic feet per second*
Shenango	Shenango River	54	127,000	100	[1] 300
Berlin [2]	Mahoning River	94	71,000	113	[3] 160
Eagle Creek	Eagle Creek	65	48,100	31	43
Mosquito Creek	Mosquito Creek	59	50,000	34	35

[1] Includes effect of Pymatuning.
[2] Under construction, 1942.
[3] Ultimate at Youngstown.

It is assured that low-flow control will be made available in the near future by the Berlin Reservoir project, and, during the present national emergency, it is proposed to operate the reservoir primarily for low-flow control with flood control as an incidental feature. Plans for ultimate operation contemplate its use for flood control, with secondary low-water regulation. The Berlin project, operated in conjunction with existing Milton Reservoir several miles downstream, will permit sustaining a minimum flow of about 250 second-feet in the Mahoning River at Youngstown, Ohio, during the national emergency period, and about 160 second-feet under the ultimate plan of operation. The Eagle and Mosquito Creek projects would be

capable of further augmenting discharge in the main river as well as increasing minimum flows in their respective tributary channels.

The Shenango project, if provided, would be operated with due regard for flow regulation originating in the Pymatuning Reservoir, which is situated farther upstream. Proposed operations contemplate increasing the regulated flow of the Shenango River by 100 second-feet during the months of June to September, inclusive. Minimum regulated discharge at Sharon, Pa., which would reflect operation of both reservoirs, would approximate 300 second-feet during these months.

Discussion

Youngstown district.—The Mahoning and Beaver Rivers are among the most grossly polluted streams in the Ohio Basin, if not in the entire country. In the 25-mile stretch of the Mahoning from Warren to Lowellville, untreated sewage from 280,000 people, industrial wastes equivalent to sewage from an additional 150,000 people and about 32 tons of sulfuric acid per day are discharged to the river whose flow has fallen to less than 50 cubic feet per second. A total of about 630 million gallons per day (about 980 cubic feet per second) is used by the industries, principally for cooling water, in this same stretch of river with the result that the temperature rises to 30°–40° F. above normal during low-flow periods. These increased temperatures hinder production and increase costs. At certain times steel production has had to be reduced because of low-stream flows. Increased temperatures also accelerate the decomposition of the organic matter present in the sewage and industrial wastes and reduce the amount of dissolved oxygen which the water can contain. Both of these effects tend to aggravate nuisance conditions in the stream. Complete depletion of the dissolved oxygen in the Mahoning was found at several points during the survey.

Three public water supplies from the Beaver River are affected by all the wastes entering the Mahoning as well as the treated wastes which are discharged to the Shenango River. Taste and odor problems are particularly acute at these places and even after very complete and careful treatment the finished water is often malodorous and unpalatable.

Survey information on taste and odor determinations on the Mahoning River were released to the State of Ohio and served as a basis for phenol-control discussion with the industries. As a result, it is reported that the efficiency of phenol-removal measures has been greatly increased.

Sewage and industrial waste treatment is obviously necessary both to improve conditions locally along the Mahoning and to relieve the heavy pollution of the Beaver River water supplies. The intensive development of the river valley in the Youngstown area where industrial plants and railroads occupy almost all of the available space will complicate the sewage-treatment problem. Complete treatment would be much more expensive than usual because of the difficulty of acquiring suitable sites. There seems to be no economic justification for attempting to maintain a dissolved oxygen level suitable for fish propagation in this stretch of the river. The high temperature of the river water would make the stream unsuitable for any fish native to

this area and the highly industrialized nature of the valley makes the stream unattractive for recreational use.

Chemical treatment of sewage and such industrial wastes as can be effectively treated in the municipal plants together with a maximum of recovery and reuse of wastes at the byproduct coke plants (with particular attention to phenol removal), neutralization, or other treatment of acid wastes are essential elements in a practicable program for pollution abatement in the Mahoning Valley.

Low-flow augmentation by reservoirs seems to be another essential part of any practicable program for improving the stream quality. Such low-flow control would reduce stream temperatures and benefit industrial water users and would reduce the hardness of the water as well as supplement sewage treatment and industrial waste corrective measures in the abatement of pollution from organic wastes. The benefits from low-flow control by the Berlin Reservoir now (1942) under construction are estimated at $251,000 annually, provided the entire capacity is used for flow regulation as is planned for the period of the national emergency. The approximate distribution of the annual benefits is as follows:

Organic pollution abatement	$133,000
Industrial water supply—temperature reduction and increased industrial activity made possible	112,000
Hardness reduction	6,000
Total	251,000

Under the ultimate plan of operation, or after the national emergency, the reservoir will be used primarily for flood control. One-third of the reservoir capacity will be used during the off-flood season for flow regulation. Annual flow regulation benefits will then be reduced to $111,000.

Additional flow regulation by Eagle Creek and Mosquito Creek Reservoirs would have additional benefits. However, sewage treatment is necessary if full benefits are to be realized. Low-flow augmentation alone, or without the parallel program of sewage treatment. will actually have a detrimental effect on pollution conditions in the Beaver River because of decreased time of flow. This is particurlarly true as regards bacterial and taste and odor conditions.

No amount of flow regulation will entirely supplant sewage or industrial waste treatment measures but will supplement them. In the case of the most troublesome type of industrial waste, phenols, flow regulation by the proposed reservoirs would have no appreciable effect.

The Mahoning River presents a most promising situation for the advantageous use of low-flow augmentation. Monetary benefits are substantial, and intangible values connected with any program of pollution control furnish additional incentive. However, due in part to the comparatively high storage costs experienced in this locality, even the Berlin Reservoir cannot be shown to be economically feasible for low-flow control alone. A multiple-purpose project has been shown to be economically feasible.

Treatment methods as outlined and maximum emergency period low-flow control by the Berlin Reservoir, together, would still not insure the continuous maintenance of 3.0 parts per million of oxygen in the Mahoning which is regarded as a minimum necessary to prevent

nuisance conditions. However, such conditions would prevail only for a short distance and at infrequent intervals. The quality of the water at downstream water intakes would be greatly improved.

Shenango River.—There are no serious pollution problems along this stream. All of the wastes entering the river are treated and flow regulation by Pymatuning Reservoir aids further in improving the water quality. Additional regulation by the proposed Shenango Reservoir would be of value, particularly in improving the quality of water in the Beaver River but the monetary benefit would be relatively minor.

Other streams.—On the whole, the smaller tributary streams of the Beaver Basin are not heavily polluted. Almost all of the towns have sewage treatment facilities although a number of them are inadequate. In general, secondary treatment is indicated at these places. At Newton Falls and Craig Beach on the Mahoning between the proposed Berlin Reservoir and Warren and at New Brighton, the only sizable Pennsylvania town without sewage treatment, primary treatment is indicated.

Costs.—The estimated cost of the suggested program of sewage and industrial waste treatment, together with estimates of the cost of existing works and of possible programs for primary or for secondary treatment of all wastes are shown in table B–1.

TABLE B-7.—*Beaver River Basin: Ohio River pollution survey laboratory data—summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Fish Run, 3 miles below Sebring, Ohio.	BMaF 104	June 28, 1940	1	20.0	5.0	55.1	1.9	91	7.2	26	101	252
Do	do	July 10, 1940	1	24.0	5.0	58.3	1.3	4	7.6	20		260
Do	do	July 29, 1940	2	26.0	3.2	38.4	2.7	43	6.9	28		220
Mahoning River, 1 mile east of Alliance, Ohio.	BMa 104	June 28, 1940	36	20.5	7.4	81.1	1.3	93	7.4		117	
Do	do	July 10, 1940	3	24.0	5.9	69.2	1.2	4	7.6			
Do	do	July 29, 1940	6	27.0	3.7	45.5	3.2	46	7.3			
Mahoning River, 5 miles below Alliance, Ohio.	BMa 97	June 28, 1940	42	21.0	5.4	59.8	3.6	430	7.5	37	136	174
Do	do	July 10, 1940	7	24.0	4.2	49.8	3.3	73	7.6	23		194
Do	do	July 29, 1940	34	27.0	4.8	59.2	3.4	93	7.3	32		156
Mahoning River, 3 miles above Newton Falls, Ohio.	BMa 79	July 1, 1940	93	16.5	8.3	84.7	2.2	4	7.4		53	
Do	do	July 15, 1940	132	22.0	8.9	101.0	1.8	2	7.3			
Do	do	July 22, 1940	130	25.0	7.9	94.0	1.0	24	7.2			
Do	do	July 30, 1940	88	27.5	7.0	87.5	3.0	24	7.3			
Do	do	Aug. 5, 1940	86	25.0	7.4	88.1	2.6	24	7.3			
Mahoning River, lower edge of Newton Falls, Ohio.	BMa 76	July 1, 1940		16.0	7.2	72.4	1.9	230	7.4		49	
Do	do	July 15, 1940	147	21.0	7.7	85.9	1.3	43	7.5			
Do	do	July 22, 1940	167	25.0	6.9	82.8	2.2	240	7.2			
Do	do	July 30, 1940	90	26.5	5.5	67.4	3.8	460	7.2			
Do	do	Aug. 5, 1940	90	24.5	6.3	75.0	4.2	93	7.2			
Mahoning River, 4 miles below Newton Falls, Ohio.	BMa 72	July 1, 1940	147	16.0	7.9	79.2	1.8	36	7.4		58	
Do	do	July 22, 1940	213	27.5	6.7	84.4	1.6	9	7.5			
Do	do	July 30, 1940	104	26.5	5.3	65.4	2.8	2	7.2			
Do	do	Aug. 5, 1940	101	24.5	6.6	78.5	1.9	24	7.2			
Silver Creek, 2 miles above Garrettsville, Ohio.	BMaES 82	June 27, 1940		14.5	9.0	87.5	.5	4	7.4		94	
Do	do	July 29, 1940	1	25.0	8.9	106.1	.8	2	7.8	5		126
Eagle Creek, 2 miles above Garrettsville, Ohio.	BMaE 82	June 27, 1940		16.5	8.5	86.4	2.2	36	7.4	27	75	104
Do	do	July 11, 1940	3	21.0	7.0	78.0	.9	2	7.4			
Do	do	July 29, 1940	3	24.0	6.6	77.3	4.7	46	7.4			
Eagle Creek, 2 miles below Garrettsville, Ohio.	BMaE 78	July 11, 1940	20	23.0	7.4	85.0	1.4	93	7.8	18		138
Do	do	July 29, 1940	9	26.5	6.5	80.2	1.6	23	7.7	12		144

TABLE B-7.—*Beaver River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts pe million
Mahoning River bridge, north of Leavittsburg, Ohio.	BMa 64.5	July 1, 1940	477	15.0	8.5	83.5	1.7	150	7.3		55	
Do	do	July 15, 1940	248	21.0	8.5	94.7	1.5	150	7.4			
Do	do	July 22, 1940	206	26.0	7.6	92.8	1.9	9	7.5			
Do	do	July 30, 1940	105	27.0	7.5	92.4		240	7.6			
Do	do	Aug. 5, 1940	112	24.5	7.7	90.7	2.0	4	7.3	15		116
Mahoning River waterworks intake, Warren, Ohio.	BMa 56.5	July 1, 1940	567	17.0	7.7	79.5	2.4	36	7.3		47	196
Do	do	July 15, 1940	204	21.5	8.4	94.2	1.8	9	7.6	23		116
Do	do	July 22, 1940	200	26.5	7.5	91.9	1.8	9	7.4			
Do	do	July 30, 1940	106	27.5	7.7	95.7	2.5	4	7.6			
Do	do	Aug. 6, 1940	100	27.0	7.1	87.9	4.7	24	7.4	17		352
Red Run, Erie R. R. bridge below Warren, Ohio.	BMaR 56.0	July 1, 1940	5	16.0	2.4	23.6	2.9	73	7.3	16	126	
Do	do	July 15, 1940		19.5	1.5	16.4	5.0	4	7.4	10		152
Do	do	July 22, 1940	1	25.0	.5	6.4	3.8	240	7.4			
Do	do	July 30, 1940	(1)	25.5	.8	9.8	6.7	240	7.2	10		180
Do	do	Aug. 6, 1940	(1)	24.0	.6	7.3	3.8	2,400	7.8			
Mahoning River, 1 mile below Warren, Ohio.	BMa 55.0	July 1, 1940	581	18.5	6.8	73.1	3.6	430	6.6		50	
Do	do	July 15, 1940	180	24.0	2.2	26.0	10.4	930	6.1			
Do	do	July 22, 1940	200	30.0	3.0	38.7	2.9	750	7.2	14		146
Do	do	July 30, 1940	108	29.0	0	0	7.5	24,000	7.0			
Do	do	Aug. 6, 1940	116	27.5	.4	4.4	4.3	9,300	7.0			
Mahoning River, 1 mile above Niles, Ohio	BMa 51.2	July 2, 1940	594	18.0	6.6	69.6	2.5	230	6.8	64	59	122
Do	do	July 15, 1940	186	21.0	2.0	21.9	3.5	91	6.1			
Do	do	July 22, 1940	192	30.0	1.3	17.3	1.9	23	6.1			
Do	do	July 30, 1940	110	30.0	0	0	1.8	43	6.0			
Do	do	Aug. 6, 1940	132	28.0	0	0	2.3	43	6.1			
Walnut Creek, 1 mile above Cortland, Ohio.	BMaMW 63.0	June 27, 1940	1	16.5	8.1	82.4	1.5	75	7.2	14	87	94
Do	do	July 11, 1940	14	22.0	5.2	58.9	1.0	2,400	6.6	21		78
Do	do	Aug. 5, 1940	(1)	24.5	1.4	17.0	13.7	4,600	7.6			

Mosquito Creek, 4 miles above Cortland, Ohio.	BMaM 64.0	June 27, 1940	23	16.5	6.4	64.9	1.5	23	7.1		78	
Do	do	July 11, 1940	3	22.0	3.4	38.8	1.0	24	7.2			
Do	do	Aug. 5, 1940	(1)	26.0	5.0	60.6	2.8	23	7.5	34		170
Mosquito Creek, 2 miles below Cortland, Ohio.	BMaM 58.0	June 27, 1940	32	18.0	5.9	62.1	2.2	36	7.3	19	108	122
Do	do	July 11, 1940	19	22.5	3.5	39.9	2.7	460	6.4	34		116
Do	do	Aug. 5, 1940	(1)	25.5	5.7	69.0	2.7	4	7.4	28		148
Saw Mill Creek bridge on county road, Canfield, Ohio.	BMaMcS 60	July 3, 1940	1	22.5	12.3	140.7	3.6	36	9.2	12		256
Do	do	July 29, 1940	(1)	23.5	6.0	69.7	3.1	9	7.8	8		184
Do	do	Aug. 5, 1940	(1)	23.0	7.0	80.6	2.9	1	7.8	2		220
Mahoning River, Niles McDonald viaduct, below Niles, Ohio.	BMa 50.2	July 2, 1940	705	18.5	6.4	67.5	3.5	430	6.6		43	
Do	do	July 15, 1940		21.0	.4	4.7	2.1	91	6.1	37		136
Do	do	July 22, 1940	205	29.0	0	0	1.3	75	6.1	37		132
Do	do	July 30, 1940	111	28.0	0	0	1.6	430	6.1			
Do	do	Aug. 6, 1940	149	26.5	0	0	1.5	11,000	6.1			
Mahoning River, Liberty Street bridge, Girard, Ohio.	BMa 45.8	July 2, 1940	879	16.5	6.5	66.2	2.9	430	6.6		37	
Do	do	July 16, 1940	251	23.0	5.7	65.4	2.4	430	6.4			
Do	do	July 23, 1940	170	29.0	5.1	65.1	1.5	430	6.2			
Do	do	July 30, 1940	120	28.0	4.1	51.3	1.8	73	6.1	34		190
Mahoning River, Division Street Bridge, Youngstown, Ohio.	BMa 43	July 2, 1940	1,210	16.5	7.1	72.2	3.4	2,400	6.8		46	
Do	do	July 16, 1940	256	22.5	5.2	59.2	1.6	91	6.2			
Do	do	July 23, 1940	199	29.0	4.1	52.5	1.2	43	6.1			
Do	do	July 31, 1940	134	29.5	3.5	45.2	2.0	240	6.1			
Do	do	Aug. 6, 1940	185	29.5	2.9	37.7	.8	21	6.0			
Do	do	Aug. 9, 1940	132	29.0	3.5	45.2	2.3	430	6.4			
Do	do	Aug. 13, 1940	120	31.0	2.8	37.5	1.9	240	6.1			
Do	do	Aug. 14, 1940	115	31.0	2.7	36.0	1.6	150	6.0			
Mill Creek, 1 mile above Columbiana, Ohio.	BMaMi 57.5	June 26, 1940	4	15.5	7.9	78.5	1.4	43	7.8		250	
Do	do	June 28, 1940	4	18.0	6.1	63.6	.4	46	7.8			
Do	do	July 10, 1940	1	19.5	3.8	40.6	3.4	460	7.5			
Mill Creek, 1 mile below Columbiana, Ohio.	BMa Mi 55.5	June 26, 1940	15	15.0	7.4	73.0	3.6	2,400	7.6	7	176	180
Do	do	June 28, 1940	15	17.0	7.2	74.1	1.1	73	7.4	8		214
Do	do	July 10, 1940	2	19.0	5.2	55.2	3.0	430	7.5	25		170
Mahoning River, Spring Common Bridge, Youngstown, Ohio.	BMa 40.2	June 25, 1940		25.0	4.5	53.9	4.1	2,400	7.0		44	
Do	do	July 2, 1940	1,290	17.0	6.7	68.4	3.4	930	6.9	47		112
Do	do	July 16, 1940	259	24.5	2.7	31.6	3.2	2,400	6.5			
Do	do	July 23, 1940	178	32.5	2.1	28.6	2.4	2,400	6.6			
Do	do	July 31, 1940	140	33.0	2.4	33.5	3.9	9,300	6.3			
Do	do	Aug. 6, 1940	187	31.5	.8	10.6	6.4	4,600	6.7	8		204
Do	do	Aug. 9, 1940	134	31.5	2.3	30.6		9,300	6.7			
Do	do	Aug. 13, 1940	124	32.5	1.9	25.5	5.0	4,600	6.6			
Do	do	Aug. 14, 1940	117	32.0	1.8	24.3	5.4	4,600	6.7			

[1] Less than 1.

TABLE B-7.—*Beaver River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness parts per million
Crab Creek, Applegate Road, Youngstown, Ohio.	BMaC 41	July 2, 1940	17	15.5	9.3	92.4	1.1	21	7.2		67	
Do	do	July 16, 1940	1	18.5	7.5	79.1	1.1	4	7.5			
Do	do	July 23, 1940	2	25.0	3.8	45.6	1.0	23	7.4			
Do	do	July 31, 1940	1	25.0	5.9	69.9	1.9	240	7.4			
Do	do	Aug. 6, 1940	1	22.5	5.2	59.3	1.4	93	7.5			
Do	do	Aug. 9, 1940	1	22.0	6.2	70.6	.9	24	7.6			
Do	do	Aug. 13, 1940	(1)	25.0	5.7	67.5	4.5	9	7.4			
Do	do	Aug. 14, 1940	(1)	24.5	6.1	72.4	2.0	24	7.4			
Crab Creek Bridge on Federal Ave., Youngstown, Ohio.	BMaC 39.2	July 2, 1940	35	15.5	5.4	54.0	28.6	46,000	7.4	12	124	168
Do	do	July 16, 1940	10	18.5	0	0	33.2	46,000	7.3	32		164
Do	do	July 23, 1940	8	22.0	0	0	48.3	460,000	7.2	29		166
Do	do	July 31, 1940	8	22.5	0	0	22.8	93,000	7.3	26		240
Do	do	Aug. 6, 1940	9	23.0	0	0	24.7	93,000	7.2	23		222
Do	do	Aug. 9, 1940	6	22.0	0	0	28.0	240,000	7.3	21		204
Do	do	Aug. 13, 1940	4	24.0	0	0	57.4	240,000	7.2	35		208
Do	do	Aug. 14, 1940	4	23.5	0	0	38.2	240,000	7.2	23		176
Gibson Run, Poland Ave., Youngstown, Ohio.	BMaG 38.5	June 25, 1940	1	21.5	5.1	57.0	12.4	36	9.6	42	690	680
Do	do	July 3, 1940	2	15.0	8.0	78.6	12.3	240	9.0	8	213	244
Do	do	July 16, 1940	2	18.5	7.1	75.0	11.2	24,000	9.0	17		310
Do	do	July 23, 1940	2	22.5	1.1	12.9	32.1	2	10.1			580
Do	do	July 31, 1940	2	21.5	.4	4.0	39.1	150,000	8.4	25		300
Do	do	Aug. 6, 1940	2	22.0	6.0	68.2	19.8	2,400	9.7	21		202
Do	do	Aug. 9, 1940	1	20.0	7.2	78.6	6.2	910	9.3	12		330
Do	do	Aug. 13, 1940	1	22.5	6.0	68.1	12.7	21,000	9.0	21		288
Do	do	Aug. 14, 1940	1	22.0	5.5	61.9	21.3	15,000	9.1	18		252
Mahoning River, Center Street Bridge, Youngstown, Ohio.	BMa 37.0	June 25, 1940	440	25.0	2.4	28.6	5.8	2,400	7.1		54	
Do	do	July 3, 1940	1,010	18.0	5.2	54.2	3.9	750	7.2			
Do	do	July 16, 1940	298	25.0	0	0	8.9	15,000	6.7			
Do	do	July 23, 1940	184	32.5	0	0	12.7	930	8.8			
Do	do	July 31, 1940	104	35.0	.5	7.1	9.0	7,500	6.9			
Do	do	Aug. 7, 1940	120	30.5	0	0	10.2	24,000	6.8			
Do	do	Aug. 9, 1940	119	30.0	7.2	94.5	10.9	15,000	7.0			
Do	do	Aug. 13, 1940	125	32.0	0	0	15.5	24,000	6.6			
Do	do	Aug. 14, 1940	123	34.0	0	0	8.6	4,300	6.6			

Mahoning River, Youngstown Sheet & Tube Bridge, Youngstown, Ohio.	BMa 36.0	June 25, 1940	450	26.5	2.6	32.2	5.2	430	7.1		39	
Do	do	July 3, 1940	1,050	19.0	5.2	55.1	5.3	1,200	7.0			
Do	do	July 16, 1940	287	26.0	0	0	16.6	4,300	6.4	46		146
Do	do	July 23, 1940	210	32.5	0	0	15.1	9,300	6.6			
Do	do	July 31, 1940	161	34.5	0	0	16.0	9,300	6.5			
Do	do	Aug. 7, 1940	135	32.5	0	0	8.8	15,000	6.3			
Do	do	Aug. 9, 1940	139	29.5	0	0	10.5	4,300	6.4			
Do	do	Aug. 13, 1940	134	32.5	0	0	16.4	4,300	6.4			
Do	do	Aug. 14, 1940	130	33.0	0	0	10.8	930	6.1			
Mahoning River Bridge in Lowellville, Ohio.	BMa 31.5	June 25, 1940	475	25.5	4.0	47.8	1.2	43	5.5		14	
Do	do	July 3, 1940	1,090	21.5	5.3	59.3	5.4	460	7.0			
Do	do	July 17, 1940	268	29.0	3.1	39.6	5.0	930	7.6			
Do	do	July 23, 1940	262	30.0	3.8	49.1	3.2	43	6.6			
Do	do	July 31, 1940	209	31.0	0	0	5.3	4	6.0			
Do	do	Aug. 7, 1940	134	29.0	.5	6.9	3.7	43	6.4			
Do	do	Aug. 9, 1940	145	30.5	0	0	.6	[1]	6.1			
Do	do	Aug. 13, 1940	140	31.5	0	0	5.6	4	7.2			
Do	do	Aug. 14, 1940	140	31.5	.9	11.4	.8 [2]1.3	2	5.5			
Mahoning River Bridge on U. S. 224, Edinburg, Pa.	BMa 26.5	June 25, 1940	490	24.5	4.2	49.7	1.8	93	6.6		29	
Do	do	July 3, 1940	1,130	21.0	5.3	58.5	4.8	240	6.8			
Do	do	July 17, 1940	216	22.0	3.1	34.9	1.8	36	7.6			
Do	do	July 23, 1940	273	28.0	3.3	42.0	2.1	4	6.8			
Do	do	July 31, 1940	223	28.5	2.4	30.7	1.9	4	6.2			
Do	do	Aug. 7, 1940	154	26.0	1.9	22.9	3.2	150	6.9			
Do	do	Aug. 9, 1940	152	26.5	3.0	36.6	3.3	2	7.0			
Do	do	Aug. 13, 1940	155	28.5	3.2	40.9	1.8	9	6.9			
Do	do	Aug. 14, 1940	155	28.0	2.6	32.7	2.0	46	6.6	8		
Mahoning River, ¼ mile above mouth.	BMa 21.5	July 5, 1940	83	19.3	5.2	55.8	4.3	93	7.4	25	55	112
Do	do	July 17, 1940	263	25.0	4.1	49.0	.7	4	7.5	27		156
Do	do	July 23, 1940	289	27.5	4.2	52.1	3.9	1	7.4	5		144
Do	do	Aug. 7, 1940	220	23.9	3.7	43.1	1.6	24	7.2			210
Mahoning River bridge on PA 108, Mahoningtown, Pa.	BMa 22.5	June 25, 1940	538	23.5	3.8	44.0	2.6	23	6.9	27	40	244
Do	do	July 3, 1940	1,260	22.0	5.1	58.2	5.9	460	6.8	47		124
Do	do	July 19, 1940	306	27.5	4.1	51.2	1.3	4	7.4	7		170
Do	do	July 31, 1940	240	28.0	3.1	38.9	2.6	9	7.3	5		212
Do	do	Aug. 7, 1940	216	24.0	2.9	34.2	2.3	9	7.3			
Do	do	Aug. 9, 1940	211	25.5	3.2	38.7	1.8	2	7.1	5		252
Do	do	Aug. 13, 1940	196	26.5	4.2	51.4	1.9	2	7.0	15		240
Do	do	Aug. 14, 1940	140	27.5	3.6	45.4	2.1	8	7.3			256
Do	do	Oct. 4, 1940		21.0	4.4	48.4	2.6	2	6.7	3	38	
Do	do	Oct. 16, 1940		11.5	5.1	46.2	2.8	11	6.7	23	62	
Do	do	Oct. 30, 1940		16.5	5.6	57.2	3.5	46	6.9	33	54	
Do	do	Nov. 15, 1940	395	12.0	5.6	51.9	1.6	2	6.7	9	45	
Do	do	Nov. 28, 1940	925	13.0	7.5	70.5	3.7	46	6.7	12	53	

[1] Less than 1.
[2] Seeded and neutralized.

TABLE B-7.—*Beaver River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Mahoning River bridge on PA 108, Mahoningtown, Pa.	BMa 22.5	Dec. 10, 1940	1,025	10.5	8.0	71.6	5.0	460	6.4	23	50	
Do	do	Dec. 20, 1940	1,505	10.0	8.4	73.8	6.7	230	6.3	85	20	
Do	do	Jan. 3, 1941	2,910	7.0	10.2	84.1	5.1	930	6.5	85	29	
Shenango River Bridge at Riverside Hotel, Greenville, Pa.	BSh 69	July 4, 1940	75	17.0	8.3	85.6	1.6	23	7.4		66	
Do	do	July 18, 1940	145	21.0	7.9	87.8	2.4	110	7.4			
Do	do	July 24, 1940	126	25.0	7.5	89.0	3.9	23	7.4			
Do	do	Aug. 1, 1940	130	20.5	7.2	79.1	6.1	43	7.2			
Do	do	Aug. 8, 1940	134	20.5	7.2	79.6	3.8	4	7.3			
Shenango River, 3 miles below Greenville, Pa.	BSh 65.5	July 4, 1940	91	18.0	7.0	73.3	2.3	73	7.4		66	
Do	do	July 18, 1940	149	21.5	6.8	76.3	3.8	240	7.1			
Do	do	July 24, 1940	138	26.0	6.6	80.5	3.1	240	7.2			
Do	do	Aug. 1, 1940	153	21.0	6.1	68.1	6.3	460	7.2			
Do	do	Aug. 8, 1940	135	20.0	6.4	70.3	5.1	390	7.3			
Shenango River, Mercer Street Bridge, Sharpsville, Pa.	BSh 52.0	July 4, 1940	293	21.0	9.2	102.0	1.8	15	7.5		58	
Do	do	July 18, 1940	313	23.5	6.7	77.9	2.2	1,100	7.2			
Do	do	July 24, 1940	183	25.5	7.3	87.5	3.0	23	7.4			
Do	do	Aug. 1, 1940	197	22.0	8.1	92.2	7.5	4	7.5			
Do	do	Aug. 8, 1940	143	20.0	7.8	84.6	2.5	24	7.3			
Shenango River, Clark Street Bridge, Sharpsville, Pa.	BSh 50.3	July 4, 1940	325	20.5	8.8	97.1	2.0	23	7.5		57	
Do	do	July 18, 1940	352	24.0	6.4	74.4	2.7	23	7.3			
Do	do	July 24, 1940	186	26.0	6.1	74.6	2.0	23	7.4			
Do	do	Aug. 1, 1940	200	22.0	6.4	73.0	6.0	24	7.4			
Do	do	Aug. 8, 1940	148	20.5	6.8	75.2	3.6	15	7.4			
Little Yankee Creek, 1½ miles above Hubbard, Ohio.	BShL 50	June 27, 1940	19	20.0	8.7	94.7	2.1	4	7.4		51	
Do	do	July 11, 1940	2	20.5	6.7	73.9	1.5	4	7.4			
Do	do	Aug. 5, 1940	2	23.0	5.6	64.7	1.7	4	7.3			
Little Yankee Creek, 4 miles below Hubbard, Ohio.	BShL 47.0	June 27, 1940	30	19.0	9.7	104.0	1.0	36	7.4	5	55	78
Do	do	July 11, 1940	6	20.5	7.2	79.4	1.1	43	7.4	30		78
Do	do	Aug. 5, 1940	3	23.5	5.9	68.5	1.7	150	7.3	12		90

Yankee Run Bridge on U S 62, at mouth.	BShY 44.5	July 4, 1940	28	19.0	9.3	99.0	1.4	2	7.3	7	48	72
Do	do	July 18, 1940	8	23.5	7.2	84.1	1.6	24	7.2	20		74
Do	do	July 24, 1940	7	25.0	4.4	52.9	1.7	460	7.1	38		88
Do	do	Aug. 1, 1940	1	21.0	5.6	62.1	2.4	93	7.1	32		84
Do	do	Aug. 8, 1940	(1)	21.5	5.0	55.6	2.3	240	7.2	13		92
Shenango River, 4 miles below Sharon, Pa.	BSh 42	July 4, 1940	417	19.5	6.8	73.3	2.9	150	7.3	15	59	84
Do	do	July 18, 1940	376	25.0	6.0	71.7	2.7	240	7.1	31		74
Do	do	July 24, 1940	190	28.0	2.8	34.8	4.5	1,500	7.0	23		62
Do	do	Aug. 1, 1940	202	24.0	3.2	37.6	10.1	4,600	7.0	30		74
Do	do	Aug. 8, 1940	154	22.0	3.2	36.5	4.9	2,400	6.9	25		84
Shenango River, 3 miles above New Castle, Pa.	BSh 27.5	July 5, 1940	401	16.0	6.2	62.5	1.3		7.2		54	
Do	do	July 19, 1940	367	24.0	5.4	63.2	2.7	93	7.3			
Do	do	July 25, 1940	236	26.0	5.8	71.0	6.0	43	7.4			
Do	do	Aug. 2, 1940	215	22.5	5.4	61.5	12.7	23	7.1			
Do	do	Aug. 7, 1940	267	22.0	7.1	80.5	11.0	93	7.3	20		112
Do	do	Aug. 12, 1940	159	25.5	5.3	63.7	7.6	240	7.1			
Neshannock Creek Bridge, Pa., 58. Mercer, Pa.	BShN 47.5	July 4, 1940	45	17.5	8.4	87.2	1.9	2	7.3		68	
Do	do	July 18, 1940	39	20.0	6.8	74.2	1.6	24	7.2			
Do	do	July 24, 1940	29	24.5	6.6	77.6	1.7	240	7.4			
Do	do	Aug. 1, 1940	4	20.3	7.1	77.7	7.6	460	7.2			
Do	do	Aug. 8, 1940	11	21.0	7.5	83.8	2.4	240	7.4			
Neshannock Creek, 1 mile below Mercer, Pa.	BShN 46.5	July 4, 1940	52	18.0	8.2	85.7	1.6	240	7.4	5	65	104
Do	do	July 18, 1940	43	20.0	5.6	61.1	1.4	930	7.2	18		104
Do	do	July 24, 1940	35	25.0	4.1	49.3	1.9	430	7.0			
Do	do	Aug. 1, 1940	12	20.0	5.0	54.1	2.6	430	7.2			
Do	do	Aug. 8, 1940	12	20.5	5.1	56.1	2.0	230	7.2			
Neshannock Creek, at mouth, upper edge of New Castle, Pa.	BShN 24.5	July 5, 1940	149	15.5	8.4	83.3	1.8	4	7.5	4	71	110
Do	do	July 19, 1940	85	23.0	8.2	94.8	3.2	2	7.5	8		114
Do	do	July 24, 1940	60	29.0	8.7	112.2	2.6	24	7.9	7		168
Do	do	July 19, 1940	85	23.0	8.2	94.8	3.2	2	7.5	8		114
Do	do	Aug. 1, 1940	48	22.5	9.4	107.9	2.3	43	8.3	3		192
Do	do	Aug. 8, 1940	25	23.0	9.4	108.5	2.3	2	7.8	4		174
Do	do	Oct. 4, 1940		13.0	10.5	98.8	1.3	(1)	6.7	5	94	
Do	do	Oct. 16, 1940		7.0	10.9	89.7	1.1	2	6.5	3	105	
Do	do	Oct. 30, 1940		10.0	10.5	92.5	.9	11	7.0	6	102	
Do	do	Nov. 15, 1940	95	3.5	12.3	92.5	.8	46	6.8	3	63	
Do	do	Nov. 28, 1940	260	3.5	13.8	103.8	2.6	240	6.6	10	47	
Do	do	Dec. 10, 1940	278	3.5	13.4	100.5	.7	43	6.1	6	34	
Neshannock Creek, mouth, New Castle, Pa.	do	Dec. 20, 1940	396	3.5	13.0	98.0	.5	93	6.5	22	29	
Do	do	Jan. 3, 1941	715	3.5	12.6	94.5	.7	230	6.6	12	29	

[1] Less than 1.
[2] Seeded and neutralized.

TABLE B-7.—*Beaver River Basin: Ohio River pollution survey laboratory data—summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Shenango River, Cherry Street Bridge, New Castle, Pa.	BSh 23.0	July 17, 1940	258	19.5	8.7	93.5	4.0	150	7.9	------	------	------
Do	do	Oct. 4, 1940	------	16.0	9.4	91.7	2.6	240	6.5	8	59	------
Do	do	Oct. 16, 1940	------	10.5	8.9	79.6	2.3	43	6.8	9	52	------
Do	do	Oct. 30, 1940	------	12.0	8.8	81.0	2.6	93	6.9	17	53	------
Do	do	Nov. 15, 1940	274	5.0	11.1	86.4	1.9	460	6.9	3	56	------
Do	do	Nov. 28, 1940	615	4.0	12.1	91.9	4.1	240	6.8	23	59	------
Do	do	Dec. 10, 1940	760	3.5	12.9	96.7	1.6	93	6.3	22	31	------
Do	do	Dec. 20, 1940	1,035	3.5	12.5	93.8	1.2	93	6.6	7	31	------
Do	do	Jan. 3, 1941	1,990	4.0	12.1	92.3	1.3	91	6.7	22	29	------
Shenango River, 1½ miles below New Castle, Pa.	BSh 21.5	July 5, 1940	422	16.0	7.5	75.7	2.2	4	7.4	9	57	78
Do	do	July 19, 1940	453	24.0	6.8	79.8	4.8	93	7.4	27	------	88
Do	do	July 25, 1940	297	22.5	5.9	69.0	5.2	23	7.4	16	------	102
Do	do	Aug. 2, 1940	258	20.0	6.7	73.3	14.1	93	7.2	21	------	114
Do	do	Aug. 12, 1940	195	23.5	7.0	81.2	5.6	75	7.2	20	------	94
Beaver River, 8 miles below Chewton Wampum Bridge, New Castle, Pa.	B 15.5	July 8, 1940	649	25.5	4.5	54.1	3.9	150	7.5	17	72	128
Do	do	July 17, 1940	672	22.0	3.9	44.0	5.4	930	7.5			
Do	do	July 25, 1940	425	26.0	2.3	27.5	9.4	230	7.2	------	------	------
Do	do	Aug. 2, 1940	396	22.0	3.5	39.2	17.2	150	7.1	------	------	------
Do	do	Aug. 7, 1940	492	24.0	2.8	33.4	8.0	930	7.1	------	------	------
Do	do	Aug. 12, 1940	380	21.5	3.7	43.7	9.2	230	7.0	------	------	------
Do	do	Oct. 4, 1940	------	17.5	5.3	54.6	4.5	460	6.7	8	45	------
Do	do	Oct. 16, 1940	------	10.5	5.5	49.1	3.2	240	6.9	9	64	------
Do	do	Oct. 30, 1940	------	13.5	5.5	52.5	5.4	230	6.8	19	57	------
Do	do	Nov. 15, 1940	772	5.0	8.1	63.5	2.1	1,100	6.7	6	52	------
Do	do	Nov. 28, 1940	1,820	8.0	9.8	82.4	4.2	4,600	6.9	25	51	------
Do	do	Dec. 10, 1940	2,158	6.5	10.6	85.8	3.4	230	6.6	23	37	------
Do	do	Dec. 20, 1940	3,080	6.0	10.1	80.8	3.3	230	6.4	55	23	------
Do	do	Jan. 3, 1941	5,925	5.0	11.3	88.0	3.7	430	6.7	55	32	------
Branch Slippery Rock Creek, 1½ miles below Slippery Rock, Pa.	BCoSl 42	July 5, 1940	38	17.5	8.8	91.0	1.2	6	7.4	15	56	86
Do	do	July 19, 1940	39	24.0	2.6	30.1	1.0	4	7.4	------	------	------
Do	do	July 26, 1940	------	26.5	6.6	81.1	.8	4	7.4	10	------	166
Slippery Rock Creek, 3 miles south of Slippery Rock, Pa.	BCoSl 42	July 19, 1940	------	24.5	7.9	93.3	.8	1	7.5	20	------	124
Wolf Creek Branch, upper edge of Grove City, Pa.	BCoSlW 47.5	July 5, 1940	24	18.5	8.2	86.6	1.4	24	7.3	------	51	------
Do	do	July 19, 1940	11	21.5	5.7	67.9	2.3	8	7.1	------	------	------
Do	do	July 26, 1940	6	26.0	6.2	75.9	1.8	4	7.0	------	------	------

Wolf Creek, 2 miles below Grove City, Pa.	BCoSlW 45.5	July 5, 1940	31	17.5	8.9	92.5	2.0	9	7.4	13	56	82
Do	do	July 19, 1940	11	22.0	9.3	105.0	2.0	2	7.6	14		108
Do	do	July 26, 1940	7	22.0	7.5	84.5	1.7	23	7.4	10		114
Slippery Rock Creek, above Ellwood City, Pa.	BCoSl 17.5	June 24, 1940	318	22.0	9.1	102.8	.9	4	7.5	14	57	94
Do	do	July 9, 1940	142	23.5	9.3	108.6	2.0	91	7.6	17		96
Do	do	July 26, 1940	66	20.0	7.8	102.8	1.4	2	7.6	10		128
Connoquenessing Creek Bridge, U S 422, Butler, Pa.	BCo 57.5	June 24, 1940	10	20.5	7.3	80.2	1.1	23	6.5		30	
Do	do	July 9, 1940	6	20.0	6.9	75.0	.7	4	6.6			
Do	do	July 26, 1940	15	29.0	3.2	40.9	1.5	7	6.8			
Connoquenessing Creek, 2 miles below Butler, Pa	BCo 54.0	June 24, 1940	35	22.0	6.5	73.2	12.4	36	6.4		25	
Do	do	July 9, 1940	22	22.0	5.7	64.2	10.7	23	6.6			
Do	do	July 26, 1940	18	30.0	1.5	19.9	1.5	4	6.2			
Connoquenessing Creek Bridge, Pennsylvania 328, Renfrew, Pa.	BCo 49.0	June 24, 1940	62	21.5	6.8	76.5	3.0	91	6.6		34	
Do	do	July 9, 1940	39	22.0	6.3	71.2	4.6	93	6.7			
Do	do	July 26, 1940	21	29.0	6.8	87.3	2.5	23	6.9			
Breakneck Creek, ¼ mile above Mars, Pa.	BCoB 46	July 8, 1940	4	21.5	10.1	113.5	1.2	46	7.6		56	
Do	do	July 25, 1940	8	23.5	4.8	55.7	5.2	4,600	7.2			
Do	do	Aug. 2, 1940	(1)	20.0	1.2	12.9	6.0	11,000	7.2			
Do	do	Aug. 12, 1940	(1)	23.0	4.3	49.1	4.9	430	7.4			
Breakneck Creek, 1½ miles below Mars, Pa.	BCoB 44.5	July 8, 1940	8	21.0	9.5	105.6	2.5	1,100	7.5		63	
Do	do	July 25, 1940	3	22.5	7.6	87.2	2.4	930	7.5			
Do	do	Aug. 2, 1940	1	19.5	7.8	84.0	2.5	230	7.3			
Do	do	Aug. 12, 1940	(1)	22.5	7.2	82.7	2.0	24,000	7.4			
Breakneck Creek, southeast corner of Evans City, Pa.	BCoB 41	July 8, 1940	24	23.0	10.6	122.6	1.9	110	7.8		64	
Do	do	July 25, 1940	5	25.5	6.1	73.5	3.1	43	7.4			
Do	do	Aug. 2, 1940	1	21.0	6.0	67.3	3.7	7	7.4			
Do	do	Aug. 12, 1940	(1)	22.5	6.1	69.7	7.4	240	7.6			
Breakneck Creek, 1 mile below Evans City, Pa.	BCoB 39.0	July 8, 1940	31	23.0	7.2	83.1	7.1	2,400	7.5	12	71	90
Do	do	July 25, 1940	6	26.5	6.7	82.1	6.5	4,300	7.4	28		112
Do	do	Aug. 2, 1940	1	20.5	4.5	49.2	15.0	4,300	7.1	33		124
Do	do	Aug. 12, 1940	(1)	23.0	0	0	19.0	36	7.1	33		140
Connoquenessing Creek, U S route 19, Harmony, Pa.	BCo 36.0	June 24, 1940	131	21.5	8.2	91.9	1.9	4	7.2		38	
Do	do	July 9, 1940	82	23.0	8.7	100.7	1.6	1	6.9			
Do	do	July 26, 1940	32	29.0	6.9	89.1	3.5	4	7.2			
Connoquenessing Creek, 2 miles below Zelionople, Pa.	BCo 31.5	June 24, 1940	149	21.5	7.7	86.5	1.8	23	7.2		37	
Do	do	July 9, 1940	93	21.5	8.0	89.9	1.3	21	7.2			
Do	do	July 26, 1940	33	29.5	7.3	94.9	3.4	93	7.4			
Connoquenessing Creek, 1½ miles above Ellwood City, Pa.	BCo 17.0	June 24, 1940	210	23.0	9.1	105.1	1.8	4	7.3	16	37	112
Do	do	July 9, 1940	123	25.5	8.9	107.1	2.0	4	7.3	20		112
Do	do	July 26, 1940	52	29.0	8.3	107.3	4.0	24	7.5	30		120

[1] Less than 1.
[2] Seeded and neutralized.

TABLE B-7—*Beaver River Basin: Ohio River pollution survey laboratory data—summary of innividual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Beaver River, Eastvale bridge, Beaver Falls, Ohio.	B 5.5	July 8, 1940	1,050	25.5	9.0	108.7	4.4	9	7.6		61	
Do	do	July 17, 1940	880	22.0	7.4	83.9	3.9	9	7.3	18		150
Do	do	July 25, 1940	690	25.0	5.9	70.9	2.5	9	7.2	13		154
Do	do	Aug. 2, 1940	640	23.0	5.1	58.6	3.8	24	7.2	15		140
Do	do	Aug. 7, 1940	690	23.0	6.1	69.8	3.2	4	7.1	7		170
Do	do	Aug. 12, 1940	570	24.0	7.3	86.0	6.1	4	7.3	16		162
Beaver River, at mouth	B 1.4	Oct. 2, 1940	620	18.0	8.4	88.3	2.1	1,100	6.5	11	34	
Do	do	Oct. 4, 1940	575	17.0	8.4	86.2	1.6	430	6.2	12	24	
Do	do	Oct. 8, 1940	640	18.0	8.5	89.0	2.6	930	6.1	9	24	
Do	do	Oct. 10, 1940	640	17.0	8.5	86.9	2.4	460	6.0	10	14	
Do	do	Oct. 14, 1940	640	17.0	8.5	87.7	3.8	150	6.2	8	47	
Do	do	Oct. 16, 1940	620	16.5	6.4	64.7	2.8	460	6.2	12	45	
Do	do	Oct. 18, 1940	640	15.0	7.8	77.0	1.9	930	6.2	12	27	
Do	do	Oct. 22, 1940	660	12.0	8.7	80.1	3.0	930	6.0	13	27	
Do	do	Oct. 24, 1940	640	12.0	9.0	83.3	2.2	2,400	6.3	11	21	
Do	do	Oct. 28, 1940	575	12.0	9.2	84.9	3.9	230	6.4	12	58	
Do	do	Oct. 30, 1940	710	13.0	7.9	74.6	1.9		6.4	37	42	
Do	do	Nov. 1, 1940	910	12.5	9.4	87.9	2.8	240	6.4	12	50	
Do	do	Nov. 5, 1940	1,320	12.5	9.8	91.8	2.4	43	6.5	22	48	
Do	do	Nov. 7, 1940	1,150	10.0	10.2	90.3	1.1	24	6.5	42	43	
Do	do	Nov. 13, 1940	2,130	9.0	11.0	94.5	1.8	110	6.8	24	47	
Do	do	Nov. 15, 1940	1,690	8.0	11.2	94.5	1.3	43	6.6	16	35	
Do	do	Nov. 19, 1940	1,150	5.0	12.2	95.3	1.8	150	6.6	20	37	
Do	do	Nov. 25, 1940	1,340	9.0	10.7	92.5	1.3	75	6.6	25	36	
Do	do	Nov. 27, 1940	2,650	7.0	11.2	92.3	1.6	460	6.6	30	35	
Do	do	Nov. 29, 1940	3,830	5.0	12.9	100.9	1.9	91	6.2	35	34	
Do	do	Dec. 3, 1940	4,000	2.0	13.2	95.4	2.1	460	7.0	50	35	
Do	do	Dec. 5, 1940	2,340	2.0	13.4	97.1	2.8	93	6.5	23	28	
Do	do	Dec. 9, 1940	4,700	4.0	13.2	100.7	2.5	150	6.8	30	30	
Do	do	Dec. 11, 1940	3,050	5.0	12.2	95.4	2.0	240	6.3	23	28	
Do	do	Dec. 13, 1940	6,200	6.5	12.0	97.5	2.3	93	6.4	20	30	
Do	do	Dec. 17, 1940	10,200	6.0	12.2	97.5	3.7	1,100	7.0	110	28	
Do	do	Dec. 19, 1940	5,930	4.0	12.9	98.1	2.1	430	6.8	50	26	
Do	do	Dec. 23, 1940	3,630	5.5	12.5	98.7	1.6	150	6.3	22	31	
Do	do	Dec. 27, 1940	2,730	7.0	11.8	97.3	1.0	1,100	7.0	23	33	
Do	do	Dec. 31, 1940	19,500	5.0	11.6	90.5	6.4	150	6.8	170	33	
Do	do	Jan. 2, 1941	15,800	5.5	12.6	99.4	3.3	210	6.6	70	28	

[1] Less than 1.

[2] Seeded and neutralized.

MUSKINGUM RIVER BASIN

CONTENTS

	Page
Contents	439
Syllabus and conclusions	441
Description	442
Presentation of field data	444
Presentation of laboratory data	446
Hydrometric data	448
Discussion	451

LIST OF TABLES

Mu-1.—Cost estimates of remedial measures	442
Mu-2.—Surface water supplies	444
Mu-3.—Sources of pollution	445
Mu-4.—Industrial wastes	446
Mu-5.—Selected laboratory data	447
Mu-6. Monthly mean summer flows	449
Mu-7.—Summary of laboratory data	454

LIST OF FIGURES

Mu-1.—Map—Sources of pollution	441
Mu-2.—Chart—Sources of pollution and selected laboratory data (Muskingum River)	444
Mu-2a.—Chart—Sources of pollution and selected laboratory data (Tuscarawas River)	444
Mu-3.—Map—Coliform results	446
Mu-4.—Map—Dissolved oxygen results	446
Mu-5.—Map—Biochemical oxygen demand results	446
Mu-6.—Chart—Summer low-flow frequency curve	450

Fig. Mu-1

Fig - Mu-1

MUSKINGUM—HOCKING BASINS

SOURCES OF POLLUTION

(Face p. 441) GPO-43 O-90035

MUSKINGUM RIVER BASIN

Syllabus and Conclusions

SYLLABUS

More than 800,000 people live in the 8,040 square miles in eastern Ohio drained by the Muskingum River. About 400,000 are in urban communities. Forty-six percent of the urban population is in the heavily industralized portion of the basin drained by the upper Tuscarawas River and Sandy Creek. In spite of the extensive efforts made to abate pollution throughout the basin, a problem remains on the upper Tuscarawas and some of its tributaries.

The lower Muskingum River and certain tributaries are considered excellent fishing streams. Natural lakes and the conservation pools at the recently completed flood-control reservoirs afford unusually good facilities for recreation. One of these, the Senecaville Reservoir, might be used to augment low flows for pollution abatement below Cambridge.

The larger streams, except the upper Tuscarawas, can be restored to or maintained in excellent condition at a reasonable cost. Further limited improvements in the quality of the more heavily polluted Tuscarawas and some of its tributaries seem economically justified.

CONCLUSIONS

(1) All but nine of the 94 public water supplies in the basin are derived entirely from underground sources. Only four of the surface supplies are from streams subject to pollution.

(2) Sewage from 422,600 people and industrial wastes with a sewered population equivalent (biochemical oxygen demand) of about 321,000 enter the streams of the basin. About two-thirds of the sewage is treated, most of it receiving secondary treatment and 56 of 84 industrial plants have taken some step to reduce pollution from industrial wastes.

(3) Laboratory studies indicate that the most heavily polluted streams are in the northeastern part of the basin in the vicinity of Canton, Massillon, and Barberton.

(4) Primary treatment of domestic sewage and removal of settleable solids from industrial wastes should suffice to maintain satisfactory stream conditions below 8 of the 10 urban communities now discharging untreated sewage. At Newark and Cambridge secondary treatment is indicated.

(5) Primary treatment seems justified at 16 and secondary treatment at 18 smaller rural communities now without sewage treatment facilities.

(6) Improvements or additions to existing sewage treatment plants are indicated at Canton, Mansfield, and seven other communities.

(7) If the Senecaville Reservoir can be used for low-flow control, primary treatment may suffice at Cambridge.

(8) The following summary of cost estimates are from table Mu-1.

Treatment	Capital cost	Annual charges
Existing	$4,550,000	$440,000
Suggested additional	5,180,000	535,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	$4,370,000	$450,000
Secondary, all places	6,200,000	660,000

TABLE MU-1.—*Muskingum River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	13	18	285,600	$4,550,000	$287,000	$153,000	$440,000
Suggested minimum correction:							
Sewage treatment plants	23	20	136,600	2,650,000	185,000	105,000	290,000
Required interceptors				2,220,000	105,000		105,000
Independent industrial waste correction				310,000	40,000	100,000	140,000
Total				5,180,000	330,000	205,000	535,000
Comparative cost:							
Primary treatment all waste				4,370,000	270,000	180,000	450,000
Secondary treatment all waste				6,200,000	400,000	260,000	660,000
As suggested				5,180,000	330,000	205,000	535,000

DESCRIPTION

The Muskingum River Basin comprises 8,040 square miles of eastern Ohio. The main stream is formed by the junction of its two principal tributaries, the Tuscarawas and Walhonding Rivers at Coshocton in about the center of the basin and flows south for 110 miles to its junction with the Ohio River at Marietta. The larger tributaries are:

Tributaries	Distance above mouth of Muskingum River (miles)	Drainage area (square miles)
Licking River	75	790
Wills Creek	99	850
Walhonding River	110	2,250
Tuscarawas River	110	2,590

There are 25 urban communities in the basin and the population density is slightly more than 100 per square mile. The populations of the larger cities and of the basin as a whole for the past 30 years are tabulated below.

	Populations			
	1910	1920	1930	1940
Larger cities:				
Canton	50, 217	87, 091	104, 906	108, 401
Zanesville	28, 026	29, 569	36, 440	37, 500
Mansfield	20, 768	27, 824	33, 525	37, 154
Newark	25, 404	26, 718	30, 596	31, 487
Massillon	13, 879	17, 428	26, 400	26, 644
Barberton	9, 410	18, 811	23, 934	24, 028
Entire basin:				
Rural	381, 840	384, 460	387, 879	413, 578
Urban	239, 011	317, 620	389, 687	398, 450
Total	620, 851	702, 080	777, 566	812, 028

Much of the basin, particularly in the northern and western parts, is fertile agricultural country. The eastern and southern portions of the area are more hilly and agriculture is less prosperous. Coal mining is important in these sections although production is generally on the decline. The principal manufactured products are steel and other metals, metal products, machinery, and clay products.

Water uses.—The Muskingum has been canalized by the construction of 11 locks and dams which maintain a navigable depth of 5 feet for 91 miles from Marietta to Dresden. The facilities are not used extensively. There are no important hydroelectric developments in the basin.

A system of 14 reservoirs, primarily for flood control, constructed by the United States Engineer Department for the Muskingum Conservancy District at a cost of $45,000,000 was completed in 1938. It has since been taken over by the Federal Government and will be operated as part of the system of reservoirs for flood control on the Ohio River and its tributaries. Eleven of the reservoirs have permanent pools. These pools and adjoining land have been leased to the Ohio Division of Conservation for development as fishing and recreational areas. Data on the capacity of the reservoirs and the area of the conservation pools are tabulated below.

No.	Reservoir	Stream	Storage (acre-feet)		Area of conservation (pool-acres)
			Total	Conservation	
1	Atwood	Indian Fork	49, 700	23, 600	1, 540
2	Beach City	Sugar Creek	71, 700	1, 700	420
3	Bolivar	Sandy Creek	149, 600	0	0
4	Charles Mills	Black Fork	88, 000	7, 400	1, 350
5	Clendening	Brush Fork	54, 000	27, 900	1, 800
6	Dover	Tuscarawas River	203, 000	1, 000	350
7	Leesville	McGuire Creek	37, 400	19, 500	1, 000
8	Mohawk	Walhonding River	285, 000	0	0
9	Mohicanville	Lake Fork	102, 000	0	0
10	Piedmont	Stillwater Creek	65, 000	33, 600	2, 270
11	Pleasant Hill	Clear Fork	87, 700	13, 500	850
12	Senecaville	Seneca Fork	88, 500	43, 500	3, 550
13	Tappan	Little Stillwater Creek	61, 600	35, 100	2, 350
14	Wills Creek	Wills Creek	196, 000	6, 000	900

These conservation pools, together with Buckeye Lake in the southwestern part of the basin and the numerous lakes in the vicinity of Akron, furnish the area with unusually good water recreation facilities. Some of the streams also are used extensively for recreation. The lower Muskingum and Wakatomica Creek are considered outstanding fishing streams.

Presentation of Field Data

Figure Mu–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figures Mu–2 and Mu–2A show similar data and, in addition, the location of water supply intakes subject to pollution and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Eighty-five of the 94 public water supplies in the basin are from underground sources. These supply almost 75 percent of the total population of 471,200 served by water supplies. The underground water is generally satisfactory in quality although it is usually hard and sometimes must be treated to remove iron. Of the nine surface water supplies, only four are from streams subject to pollution. Table Mu–2 shows data on the surface water supplies of the basin.

Table Mu–2.—*Muskingum River Basin: Surface water supplies*

Municipality	Source	Mile [1]	Treatment [2]	Population served	Consumption (million gallons per day)
	Supplies below community sewer outfalls				
Newark	North Fork Licking River	107	LD	35,000	3.20
Cambridge	Wills Creek	155	FD	15,000	1.25
Dennison	Stillwater Creek	160	FD	10,000	2.00
Marietta	Muskingum River and Wells	2	LD	14,500	1.60
	Other surface supplies				
Ashland	Jerome Creek, Long Creek	185	F [3]	12,000	0.75
Crooksville	Impounded		FD	2,300	.10
New Concord	Crooked Creek [4]		D	1,000	.08
Massillon	Wells and Newman Creek		ILD	26,600	1.50
Barberton	Impounded		FD	24,000	1.50
Total:					
Below sewer outfalls				74,500	8.05
Other				65,900	3.93
Total surface water supplies				140,400	11.98

[1] Miles above mouth of Muskingum River.
[2] I=Iron removal, L=Lime, soda softened; F=Coagulated, settled, filtered; D=Chlorinated.
[3] Softening plant under construction.
[4] Infiltration gallery.

A number of the communities which now use underground water exclusively are having difficulty in securing adequate supplies. Outstanding among these are Canton and Mansfield. In both instances heavy industrial drafts on the underground supply complicate the problem. Both of these cities may be forced to develop water supplies from surface sources.

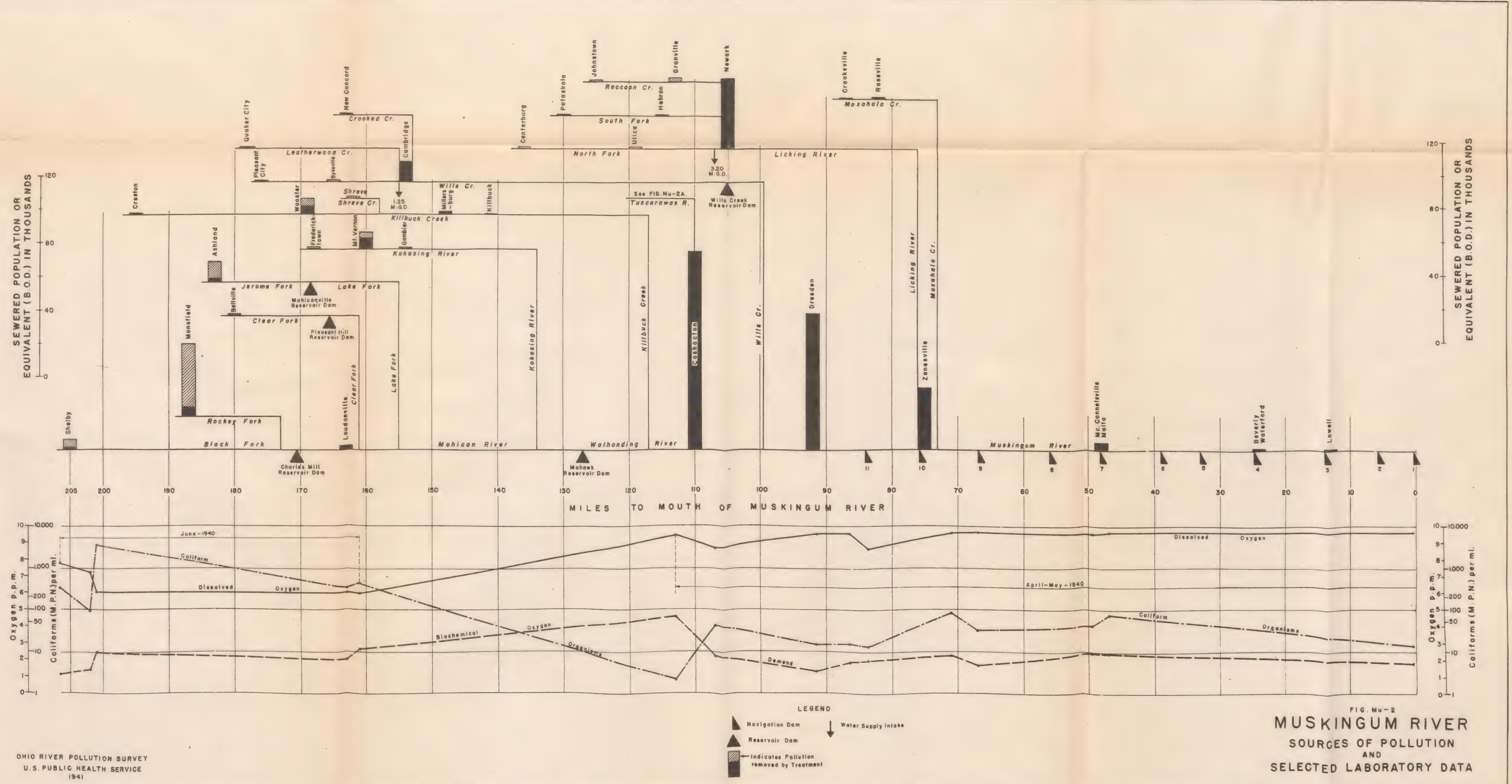


FIG. Mu-2

MUSKINGUM RIVER

SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

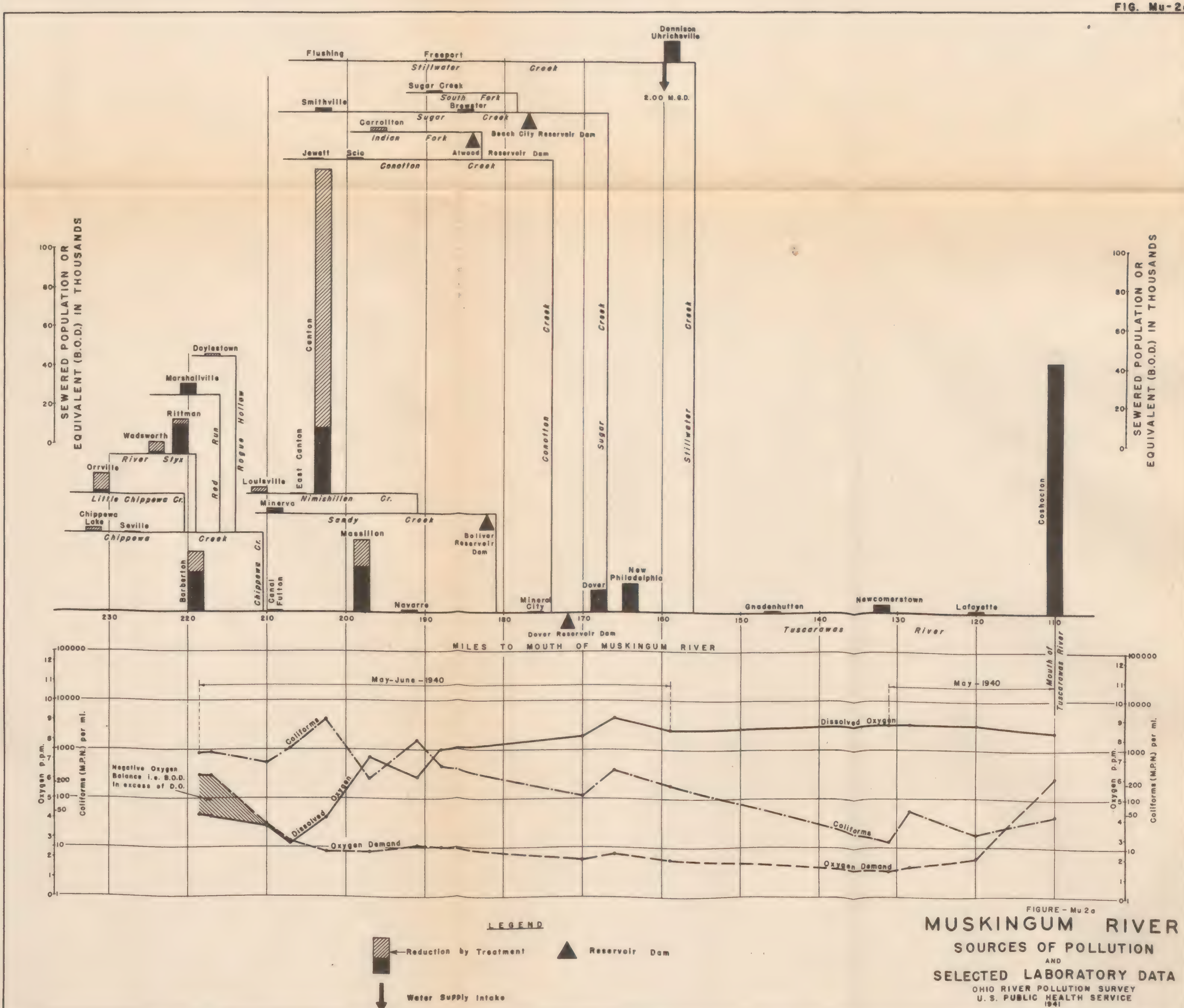


FIGURE - Mu 2a

MUSKINGUM RIVER

SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

GPO-43 0-90035

Sewerage.—Table Mu–3 shows the sewered population at each of the more important sources of pollution in the basin. About two-thirds of the total sewered population of 422,600 are served by sewage treatment plants. Thirteen primary treatment plants serve 78,700 people and 18 secondary treatment plants serve 206,900 people. The largest communities without sewage treatment are Zanesville, Newark, Cambridge, New Philadelphia, and Coshocton.

TABLE MU–3.—*Muskingum River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Stream	Miles above mouth of Muskingum River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
McConnellsville	Muskingum River	48	1,700	None	3,400	3,400
Zanesville	do	75	30,000	do	36,300	36,300
Dresden	do	92	800	do	81,000	81,000
Coshocton	do	109	10,000	do	128,100	128,100
Newcomerstown	Tuscarawas River	132	4,000	do	4,000	4,000
New Philadelphia	do	164	11,000	do	14,400	14,400
Dover	do	168	9,000	do	11,000	11,000
Massillon	do	198	28,000	Chemical	37,200	23,200
Barberton	do	219	21,500	do	30,500	19,800
Newark	Licking River	105	29,000	None	42,000	42,000
Granville	Raccoon Creek	113	2,500	Secondary	2,500	400
Cambridge	Crooked Creek	154	12,000	None	12,000	12,000
Wooster	Killbuck Creek	169	10,200	Chemical	10,200	5,100
Mount Vernon	Kokosing River	160	9,500	Primary	9,700	6,300
Ashland	Jerome Fork	183	12,000	Secondary	12,100	1,900
Mansfield	Rocky Fork	187	40,500	do	42,900	4,900
Shelby	Black Fork	225	6,000	do	6,000	900
Dennison	Little Stillwater Creek	159	4,300	None	4,300	4,300
Uhrichsville	Stillwater Creek	160	6,200	do	6,200	6,200
Canton	Nimishillen Creek	203	119,000	Secondary	161,300	26,500
Louisville	East Branch Nimishillen Creek.	211	3,300	do	3,300	400
Minerva	Sandy Creek	209	2,700	Primary	2,700	1,800
Marshallville	Red Run	220	100	None	6,000	6,000
Rittman	River Styx	221	2,800	Secondary	18,000	15,600
Wadsworth	Blockers Creek	224	6,200	do	6,200	1,000
Orrville	Little Chippewa Creek	231	4,500	do	10,100	1,500
Chippewa Lake	Chippewa Creek	232	2,500	do	2,500	400
63 smaller sources			33,300	(1)	39,300	30,800
Total			422,600		743,200	492,200

[1] 8 places have primary treatment and 8 have secondary treatment plants.

Industrial wastes.—Four strawboard and paperboard plants account for almost 75 percent of the total population equivalent of 280,500 of all the industrial wastes in the basin not treated at municipal plants. The larger steel plants, concentrated in the northeastern part of the basin around Canton and Massillon have taken steps to dispose of waste pickling liquors. An alkali plant at Barberton discharges large quantities of inorganic salts which greatly increase the hardness of the Tuscarawas River. Table Mu–4 shows data on the industrial waste producing plants.

TABLE MU-4.—*Muskingum River Basin: Summary of industrial wastes not discharged to municipal treatment plants with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlet		
Brewing	3	3		3	7,100
Byproduct coke	2		2	2	14,200
Meat	8	1	7	7	17,500
Milk	28		28	24	6,300
Oil refining	2		2	2	11,400
Paper	4		4	2	210,000
Steel	11	1	10	5	
Miscellaneous	26	10	16	11	14,000
Wastes unconnected municipal treatment	84	15	69	56	280,500
Wastes connected to municipal treatment					40,100
Total industrial waste in basin					320,600

Acid mine drainage.—Moxahala Creek is the largest acid stream in the basin. Some of the small streams in the eastern part of the basin also are acid. The mine-sealing program has reduced the amount of acid entering the streams of the Muskingum and Hocking Basins from about 215,000 tons per year to about 125,000 tons per year. Most of the abandoned mines have been sealed.

PRESENTATION OF LABORATORY DATA

The results of the dissolved oxygen and biochemical oxygen demand tests in the Muskingum River Basin showed generally good conditions at the time of sampling. Average dissolved-oxygen contents were usually over 6.5 parts per million and 5-day biochemical oxygen demand generally less than 3.0 parts per million. Coliform organisms were high, averaging over 100 per milliliter throughout most of the basin.

Summaries of the laboratory data are presented in table Mu-7 (p. 454) and selected data on the main stream and its tributaries are shown in table Mu-5. Observations were made at the mobile laboratory during April, May, and June, 1940, supplemented by observations from the laboratory boat *Kiski* in May to September, 1940 in the lower end of the basin. Figures Mu-3, Mu-4, and Mu-5 show the average coliform, dissolved oxygen, and biochemical oxygen demand results at various stations. Where observations at any point extended over more than 30 days, the most unfavorable monthly average is shown.

Fig. Mu-3

Fig. Mu-3

MUSKINGUM—HOCKING BASINS

COLIFORM RESULTS

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Mu-4

MUSKINGUM—HOCKING BASINS

DISSOLVED OXYGEN RESULTS

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Mu-5

Fig. Mu-5

MUSKINGUM—HOCKING BASINS

BIOCHEMICAL OXYGEN DEMAND

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

TABLE MU-5.—*Muskingum River Basin: Selected laboratory data*

River	Muskingum	Muskingum	Muskingum	Muskingum	Muskingum	Tuscarawas	Tuscarawas
Location	At Marietta	Below McConnellsville	Below Zanesville	Below Dresden	Below Coshocton	At Coshocton	Below Newcomerstown
River miles above mouth of Muskingum.	0.2	47	71	86.5	107	110	128.5
Period, 1940	August	August	May	April-May	May	May	May
Number of samples	11	4	3	3	2	3	3
Flow in cubic feet per second:							
Sampling days	2,050	3,140	6,117	17,433	3,215	1,520	1,430
Minimum month	----	494	----	483	----	----	227
Water temperature °C	26.4	24.9	15.0	12.5	17.3	16.7	17.8
Hardness, parts per million	----	----	----	104	256	350	244
Coliforms per milliliter	13	85	89	16	43	43	53
Dissolved oxygen, parts per million	7.5	7.5	9.5	9.8	8.8	8.4	8.8
Biochemical oxygen demand, 5-day, parts per million	2.0	2.6	2.2	1.8	2.1	6.1	1.5

River	Tuscarawas	Tuscarawas	Tuscarawas	Tuscarawas	Tuscarawas	Tuscarawas	Tuscarawas
Location	Below New Philadelphia	Above New Philadelphia	Above Dover	Above Navarre	Above Massillon	Below Barberton	Above Barberton
River miles above mouth of Muskingum.	159	166	170	191	202.5	217	223
Period, 1940	May–June	May–June	May–June	May–June	May–June	May–June	May–June
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	2,395	2,395	2,073	618	569	259	259
Minimum month	----	----	181	----	----	----	----
Water temperature °C	18.8	19.2	18.3	18.8	17.7	24.3	22.8
Hardness, parts per million	275	----	----	----	----	1,450	----
Coliforms per milliliter	191	389	114	1,480	4,050	889	380
Dissolved oxygen, parts per million	8.5	9.1	8.2	6.1	4.0	4.1	6.8
Biochemical oxygen demand, 5-day, parts per million	1.9	2.2	1.9	2.6	2.3	6.2	3.2

River	Styx	Chippewa Creek	Lower Chippewa Creek	Nimishillen Creek	Stillwater Creek	Stillwater Creek	Rocky Fork
Location	Below Wadsworth	Below Rittman	Below Orrville	Below Canton	Above Dennison	Below Uhrichsville	Below Mansfield
River miles above mouth of Muskingum.	221	217.5	229.5	193	165	156.5	184
Period, 1940	July	May–June	May–June	May–June	May–June	May–June	June
Number of samples	1	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	31	29	2	129	657	894	51
Minimum month	----	----	----	27.4	----	0	10.6
Water temperature °C	18.0	20.8	20.2	20.2	19.5	19.5	20.8
Coliforms per milliliter	240	8,220	8,970	6,650	96	70	15,700
Dissolved oxygen, parts per million	7.7	3.6	4.7	3.5	7.9	7.6	5.0
Biochemical oxygen demand, 5-day, parts per million	7.6	10.5	7.4	11.2	1.2	1.6	11.7

TABLE MU-5.—*Muskingum River Basin: Selected laboratory data*—Continued

River	Jerome Fork	Kokosing	Killbuck Creek	Wills Creek	Wills Creek	North Fork Licking	Licking
Location	Below Ashland	Below Mount Vernon	Below Wooster	Above Cambridge	Below Cambridge	Above Newark	Below Newark
River miles above mouth of Muskingum.	180.5	155.5	165	156.5	149	107.5	101
Period, 1940	June	June	May–June	May	May	April–May	April–May
Number of samples	2	3	3	3	3	2	3
Flow in cubic feet per second:							
Sampling days	54	628	390	387	473	38	373
Minimum month	------	------	------	------	181	------	------
Water temperature °C	19.5	20.8	18.8	15.3	16.0	13.5	11.0
Coliforms per milliliter	161	337	853	103	551	4	313
Dissolved oxygen, parts per million	4.2	7.2	6.3	7.5	6.4	10.6	9.2
Biochemical oxygen demand, 5-day, parts per million	1.4	2.2	2.4	2.3	3.0	2.3	2.1

Average dissolved oxygen results of 5.0 parts per million or less were found only below Canton and Mansfield and along the Tuscarawas River from Barberton to Massillon. High biochemical oxygen demands were observed below Barberton, Rittman, Canton, East Sparta, and Mansfield. Coliform averages of over 100 per milliliter prevailed throughout the basin at the time of sampling except along the main extremities of the Licking River and Wills Creek.

Moxahala Creek was found to be acid with pH values of 2.5 to 4.0 and phenolphthalein acidities as high as 290 parts per million.

Throughout most of the basin the alkalinity of the stream waters averaged between 100 and 200 parts per million, and the hardness was generally in the same range although below Barberton hardnesses of several thousand parts per million were found.

Stream flows were generally high during the time of the laboratory survey except in August and September. These stream-flow conditions undoubtedly tend to make the dissolved oxygen and biochemical oxygen demand results appear more favorable and the coliform results more unfavorable than would have been the case had the laboratory observations been made during the low-flow and high-temperature months.

Biological summary.—The plankton volume of the entire watershed is fairly high, ranging from 1,000 to 10,000 parts per million in the main stream to somewhat less in the principal tributaries. The streams support a good mixed-fish population.

HYDROMETRIC DATA

Forty stream-gaging stations have been maintained in the Muskingum River Basin for varying lengths of time and 34 of them are currently in operation. Many of these have been established recently in connection with the activities of the Muskingum Conservancy District. Table Mu-6 shows mean monthly summer flows during some of the low-flow years at eight selected stations.

TABLE MU-6.—*Muskingum River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Tuscarawas	Muskingum	Nimishillen Creek	Stillwater Creek
Location	Near Dover	At Dresden	At North Industry	At Uhrichsville
River miles above mouth of Muskingum	169	91	199	160
Drainage area, square miles	1,398	5,982	175	367
Period of record	1924-39	1922-39	1922-39	1922-39
Year	1932	1930	1932	1930
June ... cubic feet per second	357	1,330	44.9	14.2
July ... do	486	717	52.0	4.6
August ... do	258	483	28.0	0
September ... do	188	544	30.0	0
Year	1930	1932	1930	1939
June ... cubic feet per second	409	1,180	55.8	274
July ... do	251	1,600	31.4	152
August ... do	204	776	37.5	69.6
September ... do	217	550	33.7	5.0
Year	1939	1939	1934	1932
June ... cubic feet per second	789	3,581	63.5	31.2
July ... do	648	2,876	40.5	42.2
August ... do	374	1,622	68.3	20.8
September ... do	232	682	90.9	5.2

River	Kokosing	Killbuck Creek	Wills Creek	Licking
Location	At Millwood	At Killbuck	At Birds Run	At Toboso
River miles above mouth of Muskingum	143	141	127	93
Drainage area, square miles	472	466	730	672
Period of record	1922-39	[1] 1924-39	1928-38	1922-39
Year	1930	1932	1930	1930
June ... cubic feet per second	102	79.1	27.1	96.0
July ... do	57.7	108	9.9	59.8
August ... do	46.4	34.7	55.5	51.6
September ... do	58.9	34.8	9.8	53.8
Year	1932	1930	1932	1932
June ... cubic feet per second	99.0	106	55.4	138
July ... do	82.5	52.8	142	265
August ... do	48.9	35.6	75.7	70.3
September ... do	46.9	39.1	24.2	62.7
Year	1934	1939	1936	1925
June ... cubic feet per second	89.8	228	29.3	139
July ... do	88.9	126	56.1	223
August ... do	89.0	71.7	93.2	120
September ... do	48.4	42.9	58.4	63.0

[1] From 1924 to 1930 station was at Layland, 7 miles downstream, drainage area, 507 square miles.

Fig. Mu-6

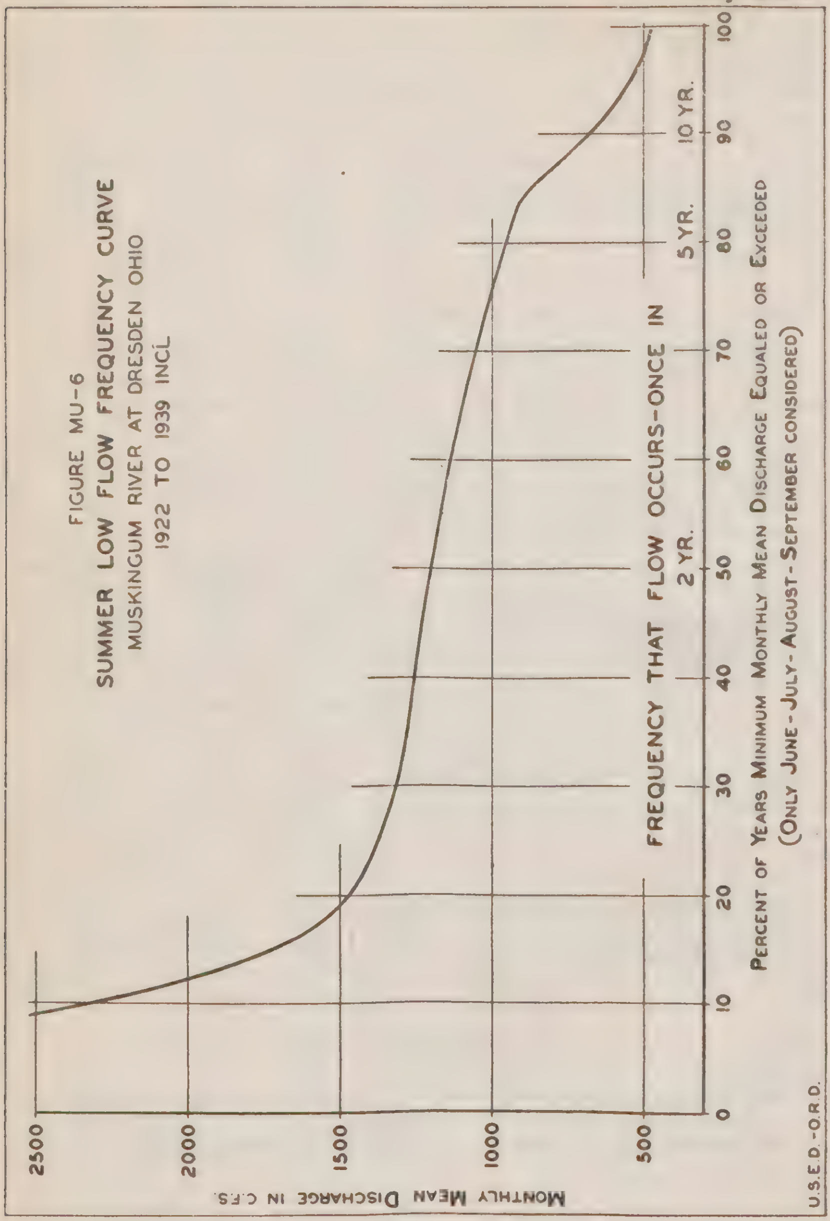


FIGURE MU-6
SUMMER LOW FLOW FREQUENCY CURVE
MUSKINGUM RIVER AT DRESDEN OHIO
1922 TO 1939 INCL.

Proposed stream control.—Three reservoir sites, in addition to the 14 already used, have been studied by the United States Engineer Department in connection with the authorized program for flood control on the Ohio River and its tributaries. These sites are on Killbuck Creek, Wakatomika Creek, and the Licking River. The existing reservoirs are not being used at present for low-flow regulation. At those reservoirs with conservation pools, regulation is limited to the maintenance of conditions approximating those that prevailed before the construction of the dams. At those without conservation pools passage of low flows is unimpeded. The reservoirs could be used for low-flow regulation but the feasibility of such use is doubtful in view of existing recreational facilities which might be damaged by attendant fluctuations in reservoir levels.

Discussion

In general, the streams of the basin, except some of those in the densely populated northeastern part of the basin and a few receiving acid mine drainage, can be restored to relatively high standards of water quality with available treatment methods at a cost which seems justified by the prospective benefits. In the northeastern section of the basin high standards of water quality cannot be achieved generally at economically justified costs with available methods of treatment. Lower standards of quality adequate to prevent serious nuisance seem practicable. Completion of the mine-sealing program will effect further reductions in the acidity of the streams. The bulk of the acid load is from active mines which would not be affected until sealing activities are modified to bring acid from worked-out sections of active mines under control.

Primary treatment is indicated at 23 places and secondary treatment at 20 places as well as improvements or additions to 10 existing plants.

Tuscarawas River.—The greatest concentration of population and industry and the most heavily polluted streams are in the northeastern part of the basin where Canton, Massillon, and Barberton are located. The larger communities in this area have sewage-treatment plants but the residual pollution after treatment, together with the industrial waste load, grossly pollutes the rather small streams that drain the area. The alkali plant at Barberton has the most far-reaching pollutional effect of any industry in the basin. The waste salts discharged increase the hardness of the Tuscarawas River to several thousand parts per million in its upper reaches and make the river throughout its length so saline as to render it undesirable as a source of water supply.

A paper plant manufacturing paperboard is located at Rittman where the receiving stream is very small. In spite of intensive efforts to reduce pollution which have resulted in recirculation of over 80 percent of the wastes and almost 90 percent reduction in the biochemical oxygen demand loading, the receiving stream is still heavily polluted. Steps should be taken to reduce the waste load further, after which continued effort to develop more efficient pollution-control measures is amply justified.

The Barberton and Massillon sewage treatment plants provide only partial treatment and although the quality of the Tuscarawas River could be improved by more refined treatment, the additional expenditure does not seem economically justified until effective steps are taken to abate industrial pollution. Present water uses along the upper Tuscarawas do not demand very high standards of water quality.

At Canton the sewage-treatment plant, though probably adequate to treat the municipal wastes, is bypassed frequently because of breakdowns in the long trunk sewer leading to the plant. Methods of insuring the continuous flow of wastes to the plant are being studied and corrective measures should be undertaken quickly. It may be found desirable to construct a new plant nearer the city.

At New Philadelphia, Dover, Dennison, and Uhrichsville stream flows are higher and primary treatment of sewage and removal of settleable solids from industrial wastes should suffice to maintain satisfactory stream conditions.

Muskingum River.—At the communities along the Muskingum, where sewage is being discharged untreated, stream flows are large enough to permit the disposal of wastes with only primary treatment. At Zanesville, Dresden, and Coshocton primary treatment of sewage and removal of settleable solids from industrial wastes should be adequate.

Three of the four paper plants, which account for two-thirds of the oxygen demand load from industrial wastes, manufacture strawboard and are located on the Muskingum River at Coshocton and Dresden where stream flows are relatively large. Recirculation systems or other measures to eliminate the discharge of settleable solids should be sufficient to maintain a satisfactory standard of water quality.

Miscellaneous pollution.—In spite of the relatively new and complete sewage-treatment plant at Mansfield, the receiving stream, Rocky Fork, a tributary of the Mohican River, is heavily polluted. General plans for the correction of the situation have been prepared involving additional sewers and increased plant capacity.

At Newark, on the Licking River, and Cambridge, on Wills Creek, secondary treatment is indicated. Plans and estimates have been prepared for a complete treatment plant at Newark. Secondary treatment is also indicated at certain small communities where wastes are discharged to streams which are practically dry during a considerable part of the year.

A large number of small cheese plants are located in the area drained by Sugar Creek and Killbuck Creek. Only a few of these are accessible to municipal sewers and a number of small industrial-treatment plants will be required.

Low-flow regulation.—Cambridge, on Wills Creek, is the only community requiring secondary treatment located below one of the existing or proposed flood-control reservoirs. The Senecaville Reservoir, about 30 miles above Cambridge, has the largest conservation pool of any of the Muskingum conservancy district reservoirs. If the entire conservation capacity were used for low-flow control, it could provide a flow of 100 cubic feet per second at the reservoir and somewhat more than that at Cambridge (see table Mu-6) during the driest year of record. Use of the entire conservation pool for flow regulation does not seem feasible in view of the recreational and other

development which has taken place at the reservoir. These developments require a reasonably constant reservoir level during the summer season and operation for flow regulation would conflict with this requirement. The determination of how much, if any, of the conservation storage might justifiably be used for flow regulation will require an appraisal of the damages which would be caused by fluctuating the reservoir level during the low-flow season.

Table Mu-1 shows the estimated cost of the suggested pollution-abatement program, of the work done to date, and of programs for primary and for complete treatment of all wastes.

TABLE MU-7.—*Muskingum River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
River Styx, above Wadsworth, Ohio	MuTStx 224	May 22, 1940	4	22.0	8.6	97.5	5.8	46	7.7		153	
Do	do	June 3, 1940	13	16.0	7.4	74.6	.5	9	7.2			
Do	do	June 10, 1940	27	22.5	6.0	68.3	1.0	240	7.4			
River Styx, 2½ miles west of Wadsworth, Ohio.	MuTStx 223.5	July 12, 1940		18.5	7.1	75.0	1.4	46	7.5			
River Styx, 3 miles below Wadsworth, Ohio.	MuTStx 221	May 22, 1940	4	21.5	10.6	119.0	3.7	43	7.9	15	174	
Do	do	June 3, 1940	13	16.5	7.6	76.8	.5	23	7.2	27		180
Do	do	June 10, 1940	27	21.5	6.4	71.7	2.0	1,100	7.3	53		164
Do	do	July 12, 1940	31	18.0	7.7	80.9	7.6	240	7.6	16		176
River Styx, ½ mile above Rittman, Ohio.	MuTStx 220.5	May 22, 1940	4	21.0	11.9	132.1	4.0	1,100	7.9	17	168	290
Chippewa Creek, 2 miles below Creston, Ohio.	MuTCh 223.5	May 28, 1940	15	16.5	8.9	90.5	1.7	240	7.5	23	127	220
Do	do	June 5, 1940	14	22.5	8.4	95.8	1.8	240	7.5	22		204
Do	do	June 10, 1940	54	25.5	6.7	80.7	2.1	460	7.5			
Chippewa Creek, ⅛ mile south of Rittman, Ohio.	MuTCh 220.5	May 22, 1940	7	20.5	10.2	112.0	3.3	24	7.8		160	
Do	do	June 3, 1940	26	16.0	7.4	74.7	.5	93	7.5			
Chippewa Creek, 2 miles below Rittman, Ohio.	MuTCh 217.5	May 22, 1940	7	23.5	0	0	24.7	24,000	7.2	32	182	310
Do	do	June 3, 1940	26	16.0	5.9	59.4	2.1	230	7.3	38		200
Do	do	June 10, 1940	54	23.0	4.8	55.1	4.6	430	7.6	73		196
Little Chippewa Creek, ¼ mile below Orrville, Ohio.	MuTChl 229.5	May 28, 1940	1	18.0	5.3	55.9	15.0	11,000	7.2	58	148	256
Do	do	June 5, 1940	1	23.5	6.4	74.1	4.7	15,000	7.4	25		184
Do	do	June 10, 1940	4	19.0	2.4	25.5	2.6	910	6.5	47		152
Tuscarawas River, 1½ miles above Barberton, Ohio.	MuT 223	May 22, 1940	50	22.0	5.8	65.1	7.3	1,100	8.4		240	
Do	do	June 3, 1940	206	21.0	8.0	88.8	1.1	36	7.6			
Do	do	June 10, 1940	521	25.5	6.8	81.3	1.2	4	7.4			
Wolf Creek, 200 feet above mouth, below Barberton, Ohio.	MuTWo 219	May 22, 1940	25	32.0	3.9	53.1	12.7	4	9.6	20	440	
Do	do	June 3, 1940	60	20.0	7.2	78.1	21.2	24	8.8	45	122	1,160
Do	do	June 10, 1940	76	25.0	5.7	67.4	10.5	460	7.3	65		620
Do	do	July 12, 1940	20	25.5	3.3	39.9	9.1	240	7.6	28		1,900

Tuscarawas River, ½ mile above sewage plant, Barberton, Ohio.	MuT 218.5	May 22, 1940	50	28.5	3.1	39.3	12.4	4	9.6		340	2,250
Do	do	June 3, 1940	206	21.0	5.4	59.7	1.0	93	8.4		131	
Do	do	June 10, 1940	521	25.5	4.2	50.5	5.3	2,400	7.8			
Do	do	July 12, 1940	69	23.5	1.3	15.5	4.5	93	7.5			
Tuscarawas River, 1 mile below sewage plant, Barberton, Ohio.	MuT 217	May 22, 1940	50	27.5	3.4	42.9	12.9	230	8.0	10	64	
Do	do	June 3, 1940	206	20.0	5.5	60.0	1.5	36	8.0	33	156	1,600
Do	do	June 10, 1940	521	25.5	3.5	41.9	4.0	2,400	7.7	42		1,300
Do	do	July 12, 1940	69	23.0	.5	5.3	6.9	930	7.4	21		5,800
Tuscarawas River, 1 mile above Canal Fulton, Ohio.	MuT 210	May 17, 1940	139	14.0	3.0	29.1	6.3	930	7.4		172	
Do	do	May 20, 1940	131	19.0	4.4	47.4	2.5	230	7.6			
Do	do	June 13, 1940	1,220	21.0	3.3	36.9	2.3	390	7.3			
Tuscarawas River, 2 miles below Canal Fulton, Ohio.	MuT 207	May 17, 1940	139	12.5	2.2	20.4	3.0	1,500	7.4	12	126	
Do	do	May 20, 1940	131	18.5	2.3	24.5	2.4	43	7.5			
Do	do	June 13, 1940	1,220	21.5	3.7	41.8	3.0	1,500	7.5			
Tuscarawas River, 3 miles above Massillon, Ohio.	MuT 202.5	May 17, 1940	159	12.5	4.0	37.5	2.5	11,000	7.5		156	
Do	do	May 20, 1940	148	19.0	4.8	50.8	1.5	230	7.5			
Do	do	June 13, 1940	1,400	21.5	3.3	37.4	2.9	930	7.5	275		
Tuscarawas River ½ mile above sewage plant Massillon, Ohio.	MuT 197	May 17, 1940	173	11.5	6.8	61.7	2.6	280	7.5		158	
Do	do	May 20, 1940	162	19.5	10.2	109.9	2.4	240	7.6			
Do	do	June 13, 1940	1,520	22.5	4.2	48.5	1.8	230	7.3			330
Tuscarawas River, city limits above Navarre, Ohio.	MuT 191	May 17, 1940	173	12.0	5.9	54.4	2.1	930	7.3		136	
Do	do	May 20, 1940	162	19.0	8.4	89.7	2.0	1,100	7.6			
Do	do	June 12, 1940	1,520	25.5	3.9	46.9	3.9	2,400	7.3			
Tuscarawas River, 2 miles below Navarre, Ohio.	MuT 188	May 17, 1940	173	13.0	8.0	75.1	1.7	430	7.5	7	154	1,470
Do	do	May 20, 1940	162	19.0	10.6	113.8	2.2	240	7.8	12		164
Do	do	June 12, 1940	1,520	25.5	3.8	46.3	3.6	750	7.3	280		322
Clear Fork of Sandy Creek, 1 mile above Minerva, Ohio.	MuTSaCl 210.5	June 11, 1940	37	25.0	7.6	90.6	.9	43	7.2	35		72
Clear Fork of Sandy Creek, ⅓ mile above Minerva, Ohio.	MuTSaCl 309.8	May 24, 1940	39	16.5	8.3	83.9	2.7	240	7.3	53	71	120
Do	do	May 29, 1940	22	17.5	9.5	99.0	4.6	43	7.2	15	58	108
Still Fork of Sandy Creek, 2 miles above Minerva, Ohio.	MuTSaS 211	June 6, 1940	33	26.0	7.9	96.2	1.0	15	7.2			64
Do	do	June 11, 1940	18	24.5	6.3	74.8	1.1	23	7.2			
Still Fork of Sandy Creek, 1 mile above Minerva, Ohio.	MuTSaS 210	May 29, 1940	35	17.0	8.7	89.5	8.6	43	7.1			
Sandy Creek, ½ mile below disposal plant, Minerva, Ohio.	MuTSa 208	May 24, 1940	39	16.5	7.3	74.4	8.5	4,600	7.3	45	87	156
Do	do	May 29, 1940	22	18.0	8.7	90.9	3.5	9,300	7.3	25		96
Do	do	June 6, 1940	18	25.5	8.0	96.0	1.2	430	7.3	22		74
Do	do	June 11, 1940	37	23.5	6.6	76.3	1.2	930	7.2	55		66
Sandy Creek, 1½ miles above Malvern, Ohio.	MuTSa 205.5	do	123	23.5	6.4	74.3	1.4	43	7.2			

TABLE MU-7.—*Muskingum River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Pipe Run, 1 mile above Malvern, Ohio.	MuTSaP 205.5	May 24, 1940	11	16.0	7.5	75.6	2.7	240	7.0		41	
Do	do	June 11, 1940	10	23.0	6.8	78.3	.9	36	7.2	23		62
Sandy Creek, 3 miles below Malvern, Ohio.	MuTSa 201	May 24, 1940	141	16.0	7.6	76.0	1.6	93	7.3	40	89	200
Do	do	June 11, 1940	133	24.5	6.8	80.6	1.7	150	7.5	52		74
Sandy Creek, city limits above Waynesburg, Ohio.	do	May 24, 1940	330	15.5	7.5	74.4	.7	24	7.2		105	
Sandy Creek, 2½ miles below Waynesburg, Ohio.	MuTSa 197	do	364	14.5	8.3	81.0	1.7	43	6.9	37	48	232
Nimishillen Creek, East Branch, ½ mile above Louisville, Ohio.	MuTNiE 211.5	May 21, 1940	1	19.0	9.6	102.6	2.5	93	7.6		152	
Do	do	May 29, 1940	16	17.0	11.2	114.5	1.4	43	7.8			
Do	do	June 6, 1940	13	23.0	9.0	104.3	.6	43	7.6			
Nimishillen Creek, East Branch, 3 miles below Louisville, Ohio.	MuTNiE 206.5	May 21, 1940	1	19.0	10.4	111.3	1.5	3	7.2	22	116	400
Do	do	May 29, 1940	16	17.5	5.2	53.5	1.2	110	6.9	48		330
Do	do	June 6, 1940	13	23.5	10.2	119.2	.4	4	7.6	7		280
Nimishillen Creek, Middle Branch, 1 mile above Canton, Ohio.	MuTNiM 206.5	May 21, 1940	13	18.5	10.2	107.9	2.7	93	8.0	7	169	330
Do	do	May 29, 1940	26	16.5	8.8	89.4	.9	43	7.8	20		280
Do	do	June 6, 1940	19	24.0	9.8	114.3	2.0	93	7.7	8		270
Nimishillen Creek, West Branch, 1¼ miles above Canton, Ohio.	MuTNiW 205.8	May 21, 1940	9	15.5	9.0	89.9	1.0	9	7.6	12	130	340
Do	do	May 29, 1940	20	16.0	9.9	99.6	.4	9	7.6	5		310
Do	do	June 6, 1940	15	24.0	10.5	123.0	.6	9	7.9	5		250
Saxon Run, at mouth, Canton, Ohio.	MuTNiSx 202.4	May 21, 1940	9	24.5	6.4	76.2	14.7	2	7.0	42	196	450
Do	do	May 29, 1940	32	20.0	5.6	60.7	22.0	15	6.7	150	115	440
Do	do	June 6, 1940	24	23.5	6.1	71.4	4.7	46	7.3	13		340
Nimishillen Creek, 7 miles below Canton, East Sparta, Ohio.	MuTNi 193	May 21, 1940	92	22.5	4.1	46.6	21.0	4,600	7.4	18	188	410
Do	do	May 29, 1940	171	16.0	5.2	52.2	6.8	360	7.3	14		400
Do	do	June 6, 1940	125	22.0	1.2	14.0	5.8	15,000	7.2	10		340
Indian Fork Creek, 1 mile above Carrollton, Ohio.	MuTCoI 198	May 24, 1940	13	15.5	8.3	82.7	4.9	240	7.1		58	
Do	do	June 7, 1940	6	26.0	9.6	116.7	.5	23	7.9			
Do	do	June 11, 1940	12	22.0	7.4	84.1	.6	3	7.4			

Indian Fork Creek, 1 mile below Carrollton, Ohio.	MuTCoI 195	May 24, 1940	20	15.5	6.3	62.8	14.9	2,400	7.1	160	57	112
Do	do	June 7, 1940	8	25.5	10.9	131.2	1.7	36	8.6	6		76
Do	do	June 11, 1940	18	22.5	6.9	78.4	1.7	430	7.4	14		78
Tuscarawas River, 2 miles above Dover, Ohio.	MuT 170	May 23, 1940	440	19.0	9.3	99.0	2.0	93	7.8		118	
Do	do	May 31, 1940	4,620	14.0	8.4	80.8	2.2	210	7.2			
Do	do	June 7, 1940	1,160	22.0	7.0	79.6	1.6	39	7.4			
Sugar Creek, 1 mile above Brewster, Ohio.	MuTSu 185	May 17, 1940	36	10.5	10.4	93.2	1.6	24	7.6	90	128	270
Do	do	May 20, 1940	41	18.0	10.1	106.0	.7	1	7.8			
Do	do	June 13, 1940	362	27.5	4.1	51.7	2.3	460	7.0			
Elm Run, ¾ mile above Brewster, Ohio.	MuTSuE 185	May 20, 1940	(1)	18.5	11.9	126.0	1.2	9	8.0	5	128	664
Do	do	June 13, 1940	5	20.5	7.7	84.5	1.2	240	7.1	75		112
Sugar Creek, 1 mile below Brewster, Ohio.	MuTSu 183	May 17, 1940	36	10.5	10.0	89.0	1.7	93	7.6		131	
Do	do	May 20, 1940	41	18.5	11.7	123.5	1.1	23	8.0	16		740
Do	do	June 13, 1940	362	28.0	3.5	44.7	2.3	4,600	6.8	310		100
Walnut Creek, ¾ mile south of Walnut Creek, Ohio.	MuTSuSW 190	May 27, 1940	4	15.0	9.8	96.7	1.8	240	7.3		55	
Do	do	June 4, 1940	1	20.5	8.8	97.5	1.2	75	7.4			
Goose Creek, ½ mile north of Walnut Creek, Ohio.	MuTSuSG 190	May 27, 1940	2	14.5	10.1	98.7	1.1	240	7.2	14	47	96
Do	do	June 4, 1940	1	20.5	10.5	115.2	.5	9	7.5	10		116
Walnut Creek, 2½ miles below Walnut Creek, Ohio.	MuTSwSW 187.5	May 27, 1940	7	15.0	9.6	94.9	.8	430	7.2	22	49	100
Do	do	June 4, 1940	2	21.0	8.6	95.3	7.8	91	7.2	29		108
South Fork Sugar Creek, 1 mile above Sugar Creek, Ohio.	MuTSuS 191.5	May 27, 1940	11	18.0	8.9	93.6	3.7	240	7.0		37	
Do	do	June 4, 1940	8	21.5	8.9	99.6	.9	43	7.1	27	80	
Do	do	June 12, 1940	11	25.5	7.4	89.0	2.3	75	7.2			
South Fork Sugar Creek, 3 miles below Sugar Creek, Ohio.	MuTSuS 171.5	May 27, 1940	15	16.5	9.2	93.3	1.3	43	6.2	32	20	96
Do	do	June 4, 1940	11	22.0	8.2	93.1	1.0	43	6.4	31		84
Do	do	June 12, 1940	16	25.0	7.7	91.9	.6	150	6.9	85		74
Sugar Creek, ¼ mile above Strasburg, Ohio.	MuTSu 174.5	May 23, 1940	46	17.5	8.0	82.8	1.0	(1)	7.6		114	
Do	do	May 31, 1940	801	14.5	8.5	83.0	.7	110	7.5			
Do	do	June 7, 1940	116	21.0	6.8	75.9	.4	4	7.4			
Sugar Creek, 1¼ miles below Strasburg, Ohio.	MuTSu 171.5	May 23, 1940	46	17.0	8.1	83.4	1.1	23	7.6	7	118	200
Do	do	May 31, 1940	801	14.5	8.5	83.0	1.3	240	7.2	43		188
Do	do	June 7, 1940	116	20.5	7.0	76.5	.4	9	7.3	14		160
Tuscarawas River, city limits above New Philadelphia, Ohio.	MuT 166	May 23, 1940	486	20.0	10.7	116.8	2.3	23	7.9		89	
Do	do	May 31, 1940	5,420	14.5	8.2	80.6	2.6	1,100	7.1			
Do	do	June 7, 1940	1,280	23.0	8.4	96.8	1.5	43	7.4			

[1] Less than one.

TABLE MU-7.—*Muskingum River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Tuscarawas River, 3½ miles below New Philadelphia, Ohio.	MuT 159	May 23, 1940	486	19.5	8.9	96.1	1.8	240	7.5	12	110	328
Do	do	May 31, 1940	5,420	14.0	8.7	84.0	2.3	240	7.2	110		236
Do	do	June 7, 1940	1,280	23.0	7.9	90.9	1.6	93	7.5	28		260
Little Stillwater Creek, 3 miles above Dennison, Ohio.	MuTLSti 163	May 23, 1940	274	19.5	9.4	101.5	2.0	2	7.4	32	44	100
Do	do	May 31, 1940	138	14.0	8.4	81.0	1.9	110	7.1	29		96
Do	do	June 7, 1940	297	24.0	7.5	88.3	2.3	23	7.3	17		86
Big Stillwater Creek, 3 miles above Dennison, Ohio.	MuTBSt 165	May 23, 1940	261	19.5	8.2	88.9	1.2	4	7.4		94	
Do	do	May 31, 1940	1,330	14.0	8.4	80.7	1.1	240	7.2			
Do	do	June 7, 1940	380	25.0	7.2	85.8	1.4	43	7.4			
Big Stillwater Creek, 2 miles below Uhrichsville, Ohio.	MuTBSt 156.5	May 23, 1940	535	20.5	7.9	87.0	1.5	23	7.2	26	64	112
Do	do	May 31, 1940	1,470	14.5	8.2	79.8	1.7	93	7.0	95		132
Do	do	June 7, 1940	677	23.5	6.6	76.9	1.6	93	6.9	28		98
Tuscarawas River, city limits above Newcomerstown, Ohio.	MuT 131	May 8, 1940	1,770	18.5	8.4	88.9	1.2	24	7.2		73	
Do	do	May 14, 1940	1,320	20.0	9.1	99.5	1.5	4	7.5			
Do	do	May 16, 1940	1,200	14.0	8.8	85.1	1.2	9	7.4			
Tuscarawas River, ½ mile below Newcomerstown, Ohio.	MuT 128.5	May 8, 1940	1,770	18.5	8.5	90.1	1.4	43	7.2	10	76	220
Do	do	May 14, 1940	1,320	20.0	9.1	99.5	1.7	23	7.5	12		268
Do	do	May 16, 1940	1,200	15.0	8.9	87.5	1.4	93	7.4			
Tuscarawas River, 1 mile north of West Lafayette, Ohio.	MuT 120	May 8, 1940	1,840	18.5	8.4	89.1	2.3	46	7.4		77	
Do	do	May 14, 1940	1,370	20.0	9.2	100.7	2.0	4	7.6			
Do	do	May 16, 1940	1,250	14.5	8.8	86.2	1.4	4	7.4			
Tuscarawas River, 500 feet above confluence with Walhonding River.	MuT 110	May 8, 1940	1,880	17.5	8.3	85.9	5.0	43	7.5	32	75	
Do	do	May 14, 1940	1,400	19.5	8.6	92.3	6.4	43	7.6			
Do	do	May 16, 1940	1,280	13.0	8.3	78.6	6.9	43	7.5	22		350
Black Fork, ½ mile above Shelby, Ohio.	MuWaMoBl 206	June 18, 1940	2	24.0	8.2	95.8	1.0	43	7.8		188	
Do	do	June 19, 1940	4	21.5	7.2	80.9	1.8	460	7.3			
Do	do	June 20, 1940	2	16.0	7.6	76.9	.5	460	7.5			
Black Fork, 1 mile below Shelby, Ohio.	MuWaMoBl 202.5	June 18, 1940	5	22.5	7.2	82.1	1.3	91	7.5	14	122	156

Black Fork, 2½ miles below Shelby, Ohio.	MuWaMoBl 201	June 19, 1940	12	20.5	5.4	59.7	3.1	2,400	7.1	390		120
Do	do	June 20, 1940	7	15.5	6.6	65.5	1.6	4,600	7.2	53		180
Rocky Fork, 1½ miles above Mansfield, Ohio.	MuWaMoBlR 190	June 17, 1940	17	19.5	7.6	81.5	.7	75	7.4		152	
Do	do	June 18, 1940	23	22.0	7.0	79.7	2.6	460	7.6			
Do	do	June 19, 1940	66	21.0	5.7	63.7	1.6	460	7.0			
Rocky Fork, 2½ miles below Mansfield, Ohio.	MuWaMoBlR 184	June 17, 1940	24	19.5	5.1	54.9	1.2	430	7.5	23	172	196
Do	do	June 18, 1940	33	22.5	3.0	34.4	30.7	46,000	7.0	2,200		124
Do	do	June 19, 1940	95	20.5	7.0	77.6	3.1	750	7.1	290		122
Black Fork, west edge of Loudenville, Ohio.	MuWaMoBl 163	June 14, 1940	471	23.5	6.0	69.3	2.6	23	7.5		111	
Do	do	June 17, 1940	426	21.5	5.8	65.3	1.5	460	7.5			
Do	do	June 20, 1940	459	19.0	6.4	68.4	2.0	460	7.5			
Black Fork, 1¼ miles below Loudenville, Ohio.	MuWaMoBl 161	June 14, 1940	471	21.5	6.1	68.5	3.3	430	7.3	155	108	152
Do	do	June 17, 1940	426	21.5	6.0	67.5	2.2	430	7.4	143		164
Do	do	June 20, 1940	459	19.0	6.4	68.1	2.5	430	7.4	75		142
Clear Fork, north city limits Belleville, Ohio.	MuWaMoCl 180	June 14, 1940	145	21.5	7.9	88.8	.9	120	7.7	37	118	128
Do	do	June 17, 1940	131	21.0	7.8	86.4	.4	15	7.6			
Do	do	June 19, 1940	366	21.0	7.1	79.3	1.8	1,100	7.5			
Clear Fork, 3½ miles below Belleville, Ohio.	MuWaMoCl 174.5	June 14, 1940	145	21.5	7.5	84.3	1.1	43	7.6		126	
Do	do	June 17, 1940	131	21.0	7.6	84.9	.3	9	7.6			152
Do	do	June 19, 1940	366	21.0	5.3	58.7	2.5	460	7.5	360		110
Jerome Fork, 1½ miles above Ashland, Ohio.	MuWaMoJe 183	June 14, 1940	78	20.0	7.0	76.6	.9	150	7.5		125	
Do	do	June 18, 1940	33	21.5	7.3	81.6	1.0	43	7.6			
Do	do	June 20, 1940	31	16.0	7.6	76.4	1.1	460	7.5			
Jerome Fork, 2 miles east of Ashland, Ohio.	MuWaMoJe 180.5	June 18, 1940	56	22.0	5.5	62.7	1.3	230	7.6	17		188
Do	do	June 20, 1940	52	17.0	2.8	28.6	1.4	91	6.6	12		224
Jerome Fork, 4 miles below Ashland, Ohio.	MuWaMoJe 175	June 14, 1940	130	21.5	5.4	60.8	1.0	430	7.5	58	124	176
North Branch, Kokosing River, ½ mile above Fredrickstown, Ohio.	MuWaKoN 161.5	June 17, 1940	55	20.5	8.2	90.0	.5	4	7.8		190	
Do	do	June 18, 1940	140	21.0	7.7	86.0	.5	24	7.8			
Do	do	June 19, 1940	178	21.0	7.0	78.3	1.4	240	7.5			
North Branch Kokosing River, 1 mile below Fredrickstown, Ohio.	MuWaKoN 166.5	June 17, 1940	55		7.9		.8	93	7.8	13	162	180
Do	do	June 18, 1940	140	21.0	7.4	82.8	.9	93	7.8	30		
Do	do	June 19, 1940	178	21.0	6.9	76.6	1.6	2,400	7.5			116
Kokosing River, northwest city limits Mount Vernon, Ohio.	MuWaKo 161.5	June 18, 1940	650	22.0	7.4	83.6	.9	23	7.8		168	
Do	do	June 19, 1940	825	21.5	6.7	75.5	3.5	210	7.5			
Do	do	June 20, 1940	408	18.5	8.5	90.0	.6	240	7.8			

TABLE MU-7.—*Muskingum River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Kokosing River, 2 miles below Mount Vernon, Ohio.	MuWaKo 155.5	June 18, 1940	650	21.5	6.8	76.5	2.8	430	7.8	32	157	180
Do	do	June 19, 1940	825	21.5	7.2	80.6	2.1	430	7.6	210		160
Do	do	June 20, 1940	408	19.5	7.7	83.4	1.8	150	7.5	42		176
Killbuck Creek, 1 mile above Wooster, Ohio.	MuWaKi 169	May 28, 1940	103	15.0	8.9	87.5	1.0	24	7.4		109	
Do	do	June 5, 1940	78	22.0	8.0	90.6	1.3	46	7.6			
Little Apple Creek, ¾ mile above Wooster, Ohio.	MuWaKiL 171	May 28, 1940	4	13.5	10.4	99.4	1.1	4	7.8	6	116	140
Do	do	June 5, 1940	2	21.0	9.4	104.2	.9	24	8.0	3		116
Do	do	June 12, 1940	11	22.5	7.9	90.2	1.3	24	7.4	38		96
Killbuck Creek, 2½ miles below Wooster, Ohio.	MuWaKi 165	May 28, 1940	160	15.0	7.4	73.0	2.2	430	7.5	43	115	148
Do	do	June 5, 1940	120	20.0	5.8	62.9	2.7	1,200	7.5	32		140
Do	do	June 12, 1940	890	21.5	5.8	65.0	2.3	930	7.3			
Shreve Creek, city limits above Shreve, Ohio.	MuWaKiSh 163	May 28, 1940	4	17.0	9.6	99.1	1.2	240	7.9		201	
Do	do	June 5, 1940	1	19.5	8.8	95.6	1.1	9	7.6			
Do	do	June 12, 1940	30	22.0	4.9	55.8	1.9	110	7.3			
Shreve Creek, ½ mile below Shreve, Ohio.	MuWaKiSh 161.5	May 28 1940	4	17.5	10.5	109.2	3.0	93	7.9	65	205	250
Do	do	June 5, 1940	1	18.0	9.1	95.4	.4	150	7.6	5		204
Do	do	June 12, 1940	30	21.5	7.1	79.7	1.7	1,100	7.4	77		124
Killbuck Creek, 3½ miles above Millersburg, Ohio.	MuWaKi 153	May 27, 1940	484	17.5	8.0	83.3	1.2	240	7.5		126	148
Do	do	June 4, 1940	348	20.5	7.0	77.2	1.7	230	7.6			
Killbuck Creek, 2 miles below Millersburg, Ohio.	MuWaKi 146	May 27, 1940	484	18.0	8.0	83.5	1.9	430	7.5	28	112	
Do	do	June 4, 1940	348	20.5	7.2	78.7	.8	230	7.6	25		156
Do	do	June 12, 1940	2,070	24.5	5.6	66.4		930	7.3			102
Walhonding River, 4 miles above Coshocton, Ohio.	MuWa 113	May 8, 1940	1,750	17.0	9.0	92.2	2.3	2	7.8	40	113	
Do	do	May 14, 1940	1,490	20.0	9.9	108.4	8.4	2	8.3			
Do	do	May 16, 1940	1,260	14.0	9.3	89.7	2.3	2	8.0	10	123	200
Muskingum River, 1 mile below Coshocton, Ohio.	Mu 107	May 8, 1940	3,620	15.5	8.6	85.1	1.7		7.5	32	100	272
Do	do	May 14, 1940	2,810	19.0	8.9	95.6	2.5	43	7.8	8		240

Seneca Fork, Wills Creek, Senecaville Dam.	MuWiS 181.5	May 7, 1940	108	19.5	11.0	118.8	1.7	2	7.8	20	83	
Do	do	May 10, 1940		10.5	8.5	76.1	.6	(1)	7.5	15	85	
Do	do	May 13, 1940		14.0	9.5	91.4	.7	(1)	7.6	22		132
Wills Creek, ¼ mile above Byesville, Ohio.	MuWi 166.5	May 7, 1940	233	19.5	9.1	97.9	1.4	46	7.5	56	95	120
Do	do	May 10, 1940	75	11.5	7.9	72.4	1.6	24	7.5		115	
Do	do	May 13, 1940	64	15.5	9.0	89.1	2.1	2	7.6			
Wills Creek, 1 mile below Byesville, Ohio.	MuWi 162	May 10, 1940	75	13.0	8.0	75.8	3.3	9	7.5	42	117	144
Do	do	May 13, 1940	4	15.5	8.5	84.6	1.4	9	7.4	27		176
Do	do	May 14, 1940	867	20.5	6.3	69.7	5.1	240	7.0	750		100
Wills Creek, bridge, U S 21, Cambridge, Ohio.	MuWi 156.5	May 9, 1940	120	16.0	8.6	86.4	2.3	46	7.2		108	
Do	do	May 15, 1940	625	16.5	6.2	63.5	2.9	240	7.3			
Do	do	May 16, 1940	415	13.5	7.8	74.2	1.6	23	7.3			
Leatherwood Creek, 2 miles above Cambridge, Ohio.	MuWiL 162	May 7, 1940	25	21.5	11.6	130.2	.9	2	8.3	35	84	
Do	do	May 9, 1940	22	17.0	10.4	106.3	1.6	4	7.2			
Do	do	May 10, 1940	20	15.5	10.0	99.9	1.2	4	7.9	22	104	192
Crooked Creek waterworks intake above New Concord, Ohio.	MuWiCr 165	May 7, 1940	3	18.0	10.6	111.0	.9	(1)	7.6	17	115	160
Do	do	May 8, 1940	3	15.5	7.7	76.3	1.1	3	7.5			
Do	do	May 9, 1940	3	14.0	7.5	72.1	1.1	2	7.4	17		
Crooked Creek, ¼ mile below New Concord, Ohio.	MuWiCr 162	May 8, 1940	4	15.5	7.1	70.3	1.4	93	7.3	13	114	148
Do	do	May 9, 1940	3	14.0	6.8	65.3	1.7	93	7.5			140
Do	do	May 13, 1940	2	14.0	4.5	43.3	13.9	460	7.4	20	118	152
Wills Creek, ½ mile below Cambridge, Ohio.	MuWi 149	May 9, 1940	140	17.5	7.2	74.8	2.8	460	7.2	45	106	140
Do	do	May 15, 1940	770	16.5	5.8	59.3	4.1	1,100	7.1	550		96
Do	do	May 16, 1940	510	14.0	6.2	60.0	2.0	93	7.2	55		170
Muskingum River, 1 mile east of Dresden, Ohio.	Mu 91.5	Apr. 30, 1940	19,900	15.5	9.9	98.3	.8	4	7.6		54	
Do	do	May 1, 1940	19,400	14.5	9.6	94.1	1.4	4	7.2			
Do	do	May 3, 1940	13,000	8.5	9.9	84.4	1.0	24	7.2	92		140
Muskingum River, 5 miles below Dresden, Ohio.	Mu 86.5	Apr. 30, 1940	19,900	15.0	9.8	96.4	2.8	36	7.6	115	53	108
Do	do	May 1, 1940	19,400	14.5	9.6	93.8	.2	4	7.2	80		100
Do	do	May 3, 1940	13,000	8.0	9.9	83.7	2.5	9	7.2			
Muskingum River, U. S. Lock No. 11, above Zanesville, Ohio.	Mu 83.9	May 9, 1940	5,200	14.5	8.3	81.0	1.8	4	7.5			
Do	do	May 14, 1940	4,250	19.0	9.3	99.7	2.8	24	7.7			
Do	do	May 16, 1940	4,550	14.0	8.2	78.9	3.9	12	7.5	14		230
North Fork Licking River, 1½ miles above Utica, Ohio.	MuLN 120.5	Apr. 30, 1940	44	14.5	9.8	95.5	1.2	9	7.8		173	
Do	do	May 2, 1940	39	9.0	10.9	94.2	1.2	2	7.8			
Do	do	May 3, 1940	38	7.0	11.7	96.3	2.1	4	7.5			

[1] Less than one.

TABLE MU-7.—*Muskingum River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
North Fork, Licking River, above Utica, Ohio.	MuLN 119	Apr. 30, 1940	44	14.5	9.5	92.6	1.4	15	7.8		173	
Do	do	May 2, 1940	39	9.5	10.7	93.4	1.0	110	7.8			
North Fork Licking River, 2 miles below Utica, Ohio.	MuLN 117	Apr. 30, 1940	44	15.0	9.6	95.1	1.7	430	7.7	10	174	224
Do	do	May 2, 1940	39	8.5	10.5	89.3	2.1	460	7.8			
Do	do	May 3, 1940	38	7.5	11.4	95.2	1.6	280	7.7			
North Fork Licking River, water works intake, Newark, Ohio.	MuLN 107.5	do	43	9.0	10.6	91.0	3.4	8	7.7			
Do	do	May 6, 1940	34	18.0	10.5	110.5	1.2	(1)	7.9			
Raccoon Creek, 1½ miles above Johnstown, Ohio.	MuLRa 126	Apr. 30, 1940	4	13.0	9.4	88.3	1.2	9	7.7		172	
Do	do	May 1, 1940	4	12.5	10.7	100.2	1.7	4	7.9			
Do	do	May 6, 1940	2	15.5	10.6	105.8	1.4	2	7.9			
Raccoon Creek 2½ miles below Johnstown, Ohio.	MuLRa 122.5	Apr. 30, 1940	4	13.5	9.7	92.4	1.2	4	7.7		183	
Do	do	May 1, 1940	4	12.5	10.4	97.1	1.0	2	7.9			
Do	do	May 6, 1940	2	16.5	9.8	99.4	1.3	1	7.7			
Raccoon Creek, ⅛ mile above Granville, Ohio.	MuLRa 114.5	Apr. 30, 1940	20	14.0	8.6	82.4	1.2	4	7.6		190	
Do	do	May 1, 1940	20	13.0	9.1	85.6	1.5	4	7.6			
Do	do	May 6, 1940	13	17.5	10.0	103.7	2.1	2	7.8	50		
Raccoon Creek, 3 miles below Granville, Ohio.	MuLRa 109	Apr. 30, 1940	20	13.0	9.5	89.5	2.6	150	7.7	10	190	190
Do	do	May 1, 1940	20	14.0	10.1	97.4	2.1	43	7.9			204
Do	do	May 6, 1940	13	17.0	11.3	116.2	3.1	43	8.0			244
South Fork Licking River, ½ mile above Newark, Ohio.	MuLS 107	May 2, 1940	85	10.5	9.4	83.9	2.8	4	7.7		178	
Do	do	May 3, 1940	80	8.5	10.1	86.0	2.0	4	7.8			
Licking River, 1 mile below Newark, Ohio.	MuL 101	May 1, 1940	380	14.5	8.3	81.3	3.2	240	7.6	27		
Do	do	May 2, 1940	390	9.5	9.3	80.8	1.3	210	7.6		191	
Do	do	May 3, 1940	350	9.0	10.1	87.2	1.9	460	7.8			190
Licking River, 3½ miles below Newark, Ohio.	MuL 97.5	May 1, 1940	530	14.5	8.1	79.0	2.8	240	7.6	18	196	280
Do	do	May 2, 1940	510	8.5	9.3	79.4	2.3	240	7.6	19	187	280
Do	do	May 3, 1940	500	9.0	10.1	87.1	1.8	460	7.8		13	
Licking River, 2½ miles above Zanesville, Ohio.	MuL 79.5	May 7, 1940	650	17.5	9.7	100.8	.9	1	7.8		168	
Do	do	May 9, 1940	520	14.0	9.6	92.2	.8	24	7.8		100	
Do	do	May 14, 1940	540	18.5	9.4	99.3	1.5	21	7.9			

Moxahala Creek, ¼ mile above Crooksville, Ohio.	MuMx 87.5	Apr. 16, 1940	322	10.0	10.8	95.1	.5 [2] 3.0	(1)	4.6			
Do	do	Apr. 18, 1940	581	12.0	9.8	90.1	2.6 [2] 1.4	2	4.8			
Do	do	Apr. 24, 1940	167	8.0	10.7	90.1	2.6 [2] 1.3	(1)	4.0			
Moxahala Creek, 1 mile above Crooksville, Ohio.	MuMx 88.0	May 27, 1940	67	16.0	9.0	90.3	1.2		3.0			
Do	do	June 5, 1940	49	20.0	9.0	98.4	1.1		3.1	23		
Do	do	June 14, 1940	57	22.0	8.0	90.7	.2	1	3.3	28		
Do	do	June 24, 1940	51	22.0	7.8	88.6	.9 [2] 3.0	11	3.3	105		
Do	do	July 2, 1940	26	17.5	9.0	93.7	.8 [2] .4	(1)	3.1	32		
Do	do	July 19, 1940	(1)	21.5	8.0	90.0	.6 [2] .5		2.8			
Do	do	July 29, 1940	2	25.0	7.5	89.6	.9 [2] .8		2.8			
Do	do	Aug. 6, 1940	4	23.5	7.8	91.0	1.4 [2] 1.5	(1)	2.9			
Do	do	Aug. 14, 1940	4	23.0	7.1	81.6	.7 [2] .9	(1)	2.7			
Do	do	Aug. 22, 1940	2	16.0	9.1	91.3	.9 [2] 1.5	(1)	2.7			
Do	do	Aug. 30, 1940	521	21.0	7.9	87.9	2.4 [2] 2.2	29	2.8	320		
Do	do	Sept. 9, 1940	6	18.5	9.4	99.9	0 [2] 1.1	(1)	2.5			
Do	do	Jan. 21, 1941		2.0	13.4	97.2	1.1 [2] 1.1	0	3.4	10		
Moxahala Creek, 1 mile below Crooksville, Ohio.	MuMx 85	Apr. 16, 1940	347	11.0	10.7	96.9	1.3 [2] 2.7	12	4.4			86
Do	do	Apr. 18, 1940	626	12.5	9.8	91.9	2.0 [2] 2.7	43	4.4			
Do	do	Apr. 24, 1940	180	8.5	11.0	93.8	3.1 [2] 2.0	3	3.5			
Do	do	May 27, 1940	72	16.0	8.2	82.5	1.3	4	3.0	25		
Do	do	June 5, 1940	53	19.5	8.1	87.4	.6		3.0	22		
Do	do	June 14, 1940	62	21.5	7.6	85.3	1.6	(1)	3.1	10		
Do	do	June 24, 1940	55	21.0	7.2	79.9	.7 [2] 1.6	(1)	3.0	45		
Do	do	July 2, 1940	29	17.5	8.5	87.9	.8 [2] 1.0	2	3.0	11		
Do	do	July 19, 1940	(1)	25.0	7.8	92.5	.5 [2] 1.1		2.8	6		
Do	do	July 29, 1940	2	27.5	6.8	85.1	1.0 [2] 2.6		2.8	7		
Do	do	Aug. 6, 1940	4	23.5	7.1	82.2	.9 [2] 1.8	2	2.9			
Do	do	Aug. 14, 1940	5	23.0	6.5	75.4	1.6 [2] 1.4		2.7			

[1] Less than one.

[2] Seeded and neutralized.

TABLE MU-7.—*Muskingum River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Moxahala Creek, 1 mile below Crooksville, Ohio.	MuMx 85	Aug. 22, 1940	2	17.0	7.7	79.3	1.8 [2] 1.4		2.7			
Do	do	Aug. 30, 1940	580	21.0	7.6	85.1	2.6 [2] 3.2	460	3.0	700		
Do	do	Sept. 9, 1940	6	20.0	7.6	82.7	.7 [2] .3		2.5	5		
Do	do	Jan. 21, 1941		1.0	13.6	95.7	[2] .5	(1)	3.4	30		
Moxahala Creek, 1 mile above Roseville, Ohio.	MuMx 83.5	Apr. 16, 1940	352	9.0	10.8	93.2	.8 [2] 2.9	1	4.2			
Do	do	Apr. 18, 1940	686	14.0	9.7	93.8	1.5 [2] 2.7	2	4.5			
Do	do	Apr. 24, 1940	183	8.5	10.9	93.0	2.6	4	3.3			
Do	do	May 27, 1940	73	16.0	8.6	86.4	.5	4	3.0	34		
Do	do	June 5, 1940	54	21.5	8.1	90.7	.3		3.0	25		
Do	do	June 14, 1940	63	22.5	7.9	90.5	.3	(1)	3.2	16		
Do	do	June 24, 1940	56	21.5	7.7	86.0	.7 [2] 1.4	(1)	3.0	53		
Do	do	July 2, 1940	29	18.0	8.6	89.7	.7 [2] .7	(1)	3.0	16		
Do	do	July 19, 1940	(1)	24.5	7.9	93.5	.6 [2] .9		2.9	26		
Do	do	July 29, 1940	2	27.5	7.3	91.1	.4 [2] .8		2.8	12		
Do	do	Aug. 6, 1940	4	23.5	7.5	86.9	0 [2] 1.2	11	3.0	17		
Do	do	Aug. 14, 1940	5	24.0	7.1	83.2	.8 [2] 1.2		2.9	4		
Do	do	Aug. 22, 1940	2	18.0	8.4	88.1	1.8 [2] 2.0	(1)	2.8	4		
Do	do	Aug. 30, 1940	588	20.5	7.6	83.1	2.0 [2] 1.5	460	3.2	545		
Do	do	Sept. 9, 1940	6	19.5	7.9	85.5	.8 [2] .7	23	2.6	11		
Do	do	Jan. 21, 1941		3.0	13.7	101.3	2.1 [2] .8	0	3.5	30		
Moxahala Creek, below Roseville, Ohio.	MuMx 82	Apr. 16, 1940	402	10.0	10.9	96.0	1.1 [2] 3.1	9	4.3	78		
Do	do	Apr. 18, 1940	726	14.5	9.6	93.7	1.9 [2] 1.5	9	4.4	120		

Do	do	Apr. 24, 1940	209	10.5	10.2	91.3	2.4 [2] .9	1	3.4	91	----------	150
Do	do	May 27, 1940	83	16.0	8.2	82.5	.7	4	3.0	25	----------	----------
Do	do	June 5, 1940	62	20.0	7.7	84.0	----------	----------	3.0	18	----------	----------
Do	do	June 14, 1940	72	22.0	7.6	86.1	.8	(1)	3.1	11	----------	----------
Do	do	June 24, 1940	64	21.5	7.6	84.9	1.1 [2] 2.2	----------	2.9	24	----------	----------
Do	do	July 2, 1940	33	18.5	8.3	87.5	.8 [2] 1.0	2	2.9	14	----------	----------
Do	do	July 19, 1940	(1)	22.5	6.5	74.8	.6 [2] 1.3	----------	2.8	7	----------	----------
Do	do	July 29, 1940	3	26.5	6.0	74.3	1.3 [2] 1.9	(1)	2.8	7	----------	----------
Do	do	Aug. 6, 1940	4	24.0	6.8	79.4	1.6 [2] 2.5	----------	3.0	17	----------	----------
Do	do	Aug. 14, 1940	6	24.0	6.4	75.0	1.0 [2] 2.5	(1)	2.8	4	----------	----------
Do	do	Aug. 22, 1940	2	18.0	6.4	67.1	1.7 2.3	----------	2.7	----------	----------	----------
Do	do	Aug. 30, 1940	672	21.0	7.4	81.8	2.1 [2] 3.0	325	3.3	650	----------	----------
Do	do	Sept. 9, 1940	8	19.5	7.3	78.9	.8 [2] .4	----------	2.5	----------	----------	----------
Do	do	Jan. 21, 1941	----------	3.0	13.5	100.1	1.6 [2] .4	2	3.3	30	----------	----------
Moxahala Creek, ½ mile above mouth 1 mile below Zanesville, Ohio.	MuMx 73.5	May 7, 1940	278	18.0	8.4	88.1	1.1 [2] 1.3	1	3.0	145	----------	300
Do	do	May 9, 1940	215	14.0	9.0	86.6	1.0 [2] 1.5	(1)	4.6	32	----------	176
Do	do	May 14, 1940	195	18.5	8.8	93.8	1.1 [2] 1.2	(1)	4.3	14	----------	288
Muskingum River, 4 miles below Zanesville, Ohio.	Mu 71	May 7, 1940	7,150	15.5	9.8	97.9	2.2	4	7.4	----------	93	----------
Do	do	May 8, 1940	6,000	15.5	9.5	94.5	2.1	24	7.4	----------	----------	----------
Do	do	May 9, 1940	5,200	14.0	9.2	88.8	2.5	240	7.5	28	----------	----------
Muskingum River, 7 miles below Zanesville, Ohio.	Mu 67	May 7, 1940	7,150	16.0	9.8	98.4	1.9	9	7.5	38	87	164
Do	do	May 8, 1940	6,000	15.5	9.6	95.3	.8	46	7.5	30	----------	172
Do	do	May 9, 1940	5,200	14.5	9.4	91.7	2.2	43	7.5	----------	----------	192
Muskingum River, city limits above McConnelsville, Ohio.	Mu 49	Apr. 16, 1940	25,200	11.5	12.3	112.0	2.8	24	7.1	----------	----------	----------
Do	do	Apr. 18, 1940	24,800	11.0	11.0	99.5	1.9	46	7.3	----------	----------	----------
Do	do	Apr. 24, 1940	31,500	13.0	11.4	107.5	1.3	43	7.3	----------	----------	----------
Muskingum River, ½ mile above McConnelsville, Ohio.	Mu 48.5	May 27, 1940	16,200	16.5	9.5	96.4	2.4	43	7.2	125	70	----------
Do	do	June 5, 1940	10,600	19.5	8.7	94.1	1.2	14	7.4	45	68	----------
Do	do	June 14, 1940	16,200	24.0	7.5	88.4	2.0	110	7.2	300	67	----------
Do	do	June 24, 1940	6.350	23.0	8.2	94.8	1.4	23	7.6	80	90	----------
Do	do	July 2, 1940	16,800	20.0	8.7	95.0	2.0	1,100	7.0	250	67	----------
Do	do	July 19, 1940	3,510	24.5	8.0	94.2	2.1	----------	7.8	14	107	----------

[1] Less than one.

[2] Seeded and neutralized.

TABLE MU-7.—*Muskingum River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Muskingum River, ½ mile above McConnelsville, Ohio.	Mu 48.5	July 29, 1940	5,950	28.5	7.1	90.4	2.7	4	7.5	80	79	
Do	do	Aug. 6, 1940	1,490	27.5	8.0	100.8	2.7		7.8	14	105	
Do	do	Aug. 14, 1940	1,260	27.5	6.8	84.8	2.1	(1)	7.8	12	132	
Do	do	Aug. 22, 1940	1,800	25.0	8.2	98.1	2.6	(1)	7.3	14	120	
Do	do	Aug. 30, 1940	8,040	22.0	7.8	88.1	3.6	23	7.0	89	85	
Do	do	Sept. 9, 1940	2,040	23.5	7.8	90.2	2.0	4	7.2	16	92	
Do	do	Jan. 21, 1941	8,350	1.0	14.1	98.9	1.0	83	7.5	27	78	
Muskingum River, lock wall at dam below McConnellsville, Ohio.	Mu 48	Apr. 16, 1940	25,200	10.5	12.3	109.9	2.2	46	7.0	155	50	112
Do	do	Apr. 18, 1940	24,800	9.5	11.3	98.4	2.2	110	7.2	100	276	
Do	do	Apr. 24, 1940	31,500	12.0	11.5	106.5	1.4	43	7.2		44	104
Muskingum River, 1.1 miles below McConnellsville, Ohio.	Mu 47	May 27, 1940	16,200	16.5	9.7	98.5	2.5	75	7.2	140	66	
Do	do	June 5, 1940	10,600	19.5	8.9	96.3	1.4	15	7.5	60	67	
Do	do	June 14, 1940	16,200	24.0	7.8	90.9	2.9	110	7.4	540	67	
Do	do	June 24, 1940	6,350	21.5	8.4	94.2	1.4	43	7.7	90	93	
Do	do	July 2, 1940	16,800	19.5	8.9	96.1	5.6	93	7.1	420	66	
Do	do	July 19, 1940	3,510	25.0	8.2	97.3	2.4	23	8.0	15	105	
Do	do	July 29, 1940	5,950	28.5	7.4	94.3	2.5	43	7.5	81	82	
Do	do	Aug. 6, 1940	1,490	27.0	7.5	93.2	2.7	24	8.0	16	103	
Do	do	Aug. 14, 1940	1,260	28.0	6.4	80.4	2.0	39	7.8	11	130	
Do	do	Aug. 22, 1940	1,800	22.0	8.3	93.6	2.4	46	7.5	32	118	
Do	do	Aug. 30, 1940	8,040	22.5	8.0	91.4	3.4	230	7.1	103	85	
Do	do	Sept. 9, 1940	2,040	23.5	9.8	114.5	2.3	15	7.3	18	93	
Do	do	Jan. 21, 1941	8,350	1.0	14.2	99.8	1.2	93	7.6	30	82	
Muskingum River, mile 0.2 at mouth Marietta, Ohio.	Mu 0.2	May 1, 1940	22,100	12.5	10.8	100.6	1.5	4	6.8	85	56	
Do	do	May 7, 1940	10,500	13.5	10.6	100.8	1.5	46	7.4	50	74	
Do	do	May 9, 1940	7,360	14.5	10.2	99.3	1.3	2	7.4	18	84	
Do	do	May 13, 1940	4,880	16.0	9.7	97.3	1.8	4	7.5	7	98	
Do	do	May 15, 1940	4,610	18.0	8.5	89.1	1.7	5	7.4	8	104	
Do	do	May 17, 1940	4,920	15.5	9.5	94.8	1.5	4	7.4	12	105	
Do	do	May 21, 1940	4,580	18.5	9.2	97.9	2.1	4	7.5	12	106	
Do	do	May 23, 1940	4,170	19.0	9.1	97.4	1.6	2	7.6	11	104	
Do	do	May 27, 1940	18,200	16.0	10.0	100.3	2.6	11	7.3	230	75	
Do	do	May 29, 1940	15,000	16.5	9.7	98.5	1.9	24	7.1	110	64	
Do	do	May 31, 1940	11,300	15.5	9.7	96.9	2.5	43	6.9	180	69	
Do	do	June 4, 1940	19,700	17.5	9.7	100.8	1.8	15	7.2	112	63	
Do	do	June 6, 1940	11,500	20.0	9.1	98.8	1.4	9	7.7	50	69	

Do	do	June 10, 1940	7,600	23.5	8.3	96.6	2.1	110	7.5	230	86	
Do	do	June 12, 1940	16,100	24.0	8.3	97.2	2.6	1,100	7.4	750	83	
Do	do	June 14, 1940	18,200	24.0	8.4	98.4	2.2	36	7.6	420	66	
Do	do	June 18, 1940	10,800	24.0	8.1	95.2	1.6	240	7.2	370	75	
Do	do	June 20, 1940	11,700	23.0	8.3	96.1	1.3	36	7.5	175	87	
Do	do	June 24, 1940	7,100	22.5	8.5	96.7	1.2		7.7	89	80	
Do	do	June 26, 1940	9,050	21.0	8.6	96.0	1.2	9	7.5	100	94	
Do	do	June 28, 1940	8,070	22.5	8.4	96.4	1.1	9	7.6	100	93	
Do	do	July 2, 1940	16,100	20.0	9.0	98.5	1.7	110	7.2	340	77	
Do	do	July 10, 1940	5,370	23.5	8.5	98.8	1.1	4	7.5	56	84	
Do	do	July 12, 1940	4,170	24.0	8.3	97.6	1.7	4	7.4	17	92	
Do	do	July 16, 1940	4,490	24.5	8.3	98.3	2.1	2	7.4	12	110	
Do	do	July 18, 1940	3,730	24.5	8.2	97.4	1.7	2	7.7	15	107	
Do	do	July 22, 1940	2,960	27.0	7.7	95.9	2.1	2	7.8	12	108	
Do	do	July 24, 1940	2,900	28.0	7.8	98.5	2.5	93	7.9	12	113	
Do	do	July 26, 1940	5,030	28.5	7.7	98.2	1.8	36	7.9	23	116	
Do	do	July 30, 1940	6,450	29.5	7.7	99.9	2.3		7.7	16	93	
Do	do	Aug. 1, 1940	3,880	28.0	7.9	99.7	2.1	4	7.7	17	81	
Do	do	Aug. 5, 1940	2,080	27.5	8.0	99.6	2.3	2	8.3	12	65	
Do	do	Aug. 7, 1940	1,620	27.5	7.0	88.0	2.0	5	7.8	13	78	
Do	do	Aug. 9, 1940	1,950	27.5	7.4	92.6	2.1	46	7.3	12	85	
Do	do	Aug. 13, 1940	1,470	28.0	7.4	93.4	2.1	9	7.5	12	105	
Do	do	Aug. 15, 1940	1,370	27.5	7.4	92.4	2.6	24	7.5	13	109	
Do	do	Aug. 19, 1940	1,220	26.5	7.1	87.0	1.6	4	7.6	24	124	
Do	do	Aug. 21, 1940	2,320	25.0	7.3	86.7	1.5	4	7.5	18	131	
Do	do	Aug. 23, 1940	1,950	25.0	7.5	89.9	2.1	2	7.4	18	134	
Do	do	Aug. 27, 1940	1,200	24.5	7.6	90.3	1.6	4	7.4	14	127	
Do	do	Aug. 29, 1940	3,490	23.0	7.5	86.9	2.3	43	7.3	500	80	
Do	do	Sept. 4, 1940	6,890	22.0	8.6	97.4	1.3	23	6.9	75	63	
Do	do	Sept. 6, 1940	3,640	22.5	8.4	96.0	1.3	9	6.8	55	70	
Do	do	Sept. 10, 1940	2,210	22.5	7.9	90.6	1.5	24	6.7	28	78	
Do	do	Sept. 12, 1940	2,270	20.5	8.1	89.1	1.0	4	6.6	31	83	
Do	do	Sept. 16, 1940	1,790	20.0	8.4	91.4	1.7	3	6.3	42	104	
Muskingum River, 0.2, dam No. 1	do	Jan. 15, 1941	6,020	1.5	14.0	99.6	1.4	110	7.0	20	86	
Do	do	Jan. 17, 1941	6,670	3.5	13.3	100.2	.9	240	6.9	26	91	
Do	do	Jan. 21, 1941	9,060	1.5	14.0	100.1	1.7	210	7.7	25	92	
Do	do	Jan. 23, 1941	7,740	1.5	14.1	100.5	1.2	46	7.5	35	85	
Do	do	Jan. 27, 1941	10,800	1.5	14.3	102.0	1.8	75	7.5	65	80	
Do	do	Jan. 29, 1941	10,500	.5	14.5	100.6	1.4	21	7.4	55	73	
Do	do	Jan. 31, 1941	9,550	1.0	14.4	100.9	1.6	46	7.5	25	79	
Do	do	Feb. 4, 1941	11,700	.5	13.9	96.7	1.3	150	7.5	40	77	
Do	do	Feb. 6, 1941	9,320	2.0	13.8	99.8	.9	93	7.5	35	75	
Do	do	Mar. 6, 1941	12,500	1.5	14.0	99.8	1.2	23	7.6	35	98	
Do	do	Mar 10, 1941	7,110	1.5	14.0	99.8	2.0	240	7.6	110	70	
Do	do	Mar. 12, 1941	7,600	2.0	13.7	99.3	1.6	23	7.5	15	74	
Do	do	Mar. 14, 1941	9,790	2.5	13.8	100.6	1.2	43	7.6	45	75	
Do	do	Mar. 18, 1941	8,810	0	13.9	95.1	1.1	24	7.7	35	74	
Do	do	Mar. 20, 1941	6,900	1.0	14.0	98.4	1.0	9	7.7	35	74	
Do	do	Mar. 26, 1941	5,710	4.5	12.6	97.3	1.2	24	7.7	25	121	
Do	do	Mar. 28, 1941	5,550	5.5	12.4	98.2	1.2	4	7.7	14	83	

[1] Less than one.

[2] Seeded and neutralized.

HOCKING RIVER BASIN

CONTENTS

	Page
Contents	471
Syllabus and conclusions	473
Description	474
Presentation of field data	475
Presentation of laboratory data	476
Hydrometric data	478
Discussion	478

LIST OF TABLES

H–1.—Cost estimates of remedial measures	474
H–2.—Surface water supplies	475
H–3.—Sources of pollution	476
H–4.—Industrial wastes (omitted)	---
H–5.—Selected laboratory data	477
H–6.—Monthly mean summer flows	478
H–7.—Summary of laboratory data	480

LIST OF FIGURES

H-2.—Chart—Sources of pollution and selected laboratory data	476

(Note.—For maps of this basin see Muskingum River Basin.)

HOCKING RIVER BASIN[1]

Syllabus and Conclusions

SYLLABUS

The Hocking River Basin (area 1,185 square miles) lies in the hilly country of southeastern Ohio. Of the total population of 113,000 about 40 percent is in urban communities. Coal mining and agriculture are the principal industries. None of the 16 public water supplies are taken from polluted streams. Some 48,000 people are served by sewers and about half of the sewage is treated. A number of the tributary streams are strongly acid from mine drainage. Although mine sealing has reduced the acidity, a high degree of restoration of these streams may be delayed until mine-sealing activities are modified to bring worked-out sections of active mines under control.

The remaining pollution problems of the area can be effectively dealt with by known methods of waste treatment. Flow regulation by proposed flood-control reservoirs, while desirable, would not produce appreciable tangible benefits.

CONCLUSIONS

(1) All public water supplies are from underground or upland impounded sources and are not important factors in pollution problems.

(2) Sewage from 48,400 people and industrial wastes with a population equivalent of 8,600 are discharged to sewers. About half of the sewage is treated. The industrial wastes can be treated in municipal treatment plants.

(3) Laboratory results indicate stream conditions to be generally good in this basin. Pollution problems occur below Lancaster, Logan, and Athens.

(4) Primary treatment of all wastes now discharged untreated to the main stream should be sufficient to maintain satisfactory stream conditions. Pending further control of acid mine drainage, primary treatment is probably the limit now justified on certain acid tributaries.

(5) Secondary treatment will be required to prevent local nuisances below significant sources of pollution on the remaining minor tributaries.

(6) The mine-sealing program should be revived and continued as far as practicable. Drainage from active mines constitutes an important source of acid.

[1] For maps of this basin see Muskingum River Basin.

(7) The estimated comparative costs of pollution-abatement programs, as summarized from table H-1, follow:

Treatment	Capital cost	Annual charges
Existing	$840,000	$70,000
Suggested additional	620,000	55,000

Estimated additional costs over existing charges of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	590,000	50,000
Secondary, all places	760,000	75,000

TABLE H-1.—*Hocking River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment, dollars	Annual charges (dollars)		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	2	2	24,000	840,000	50,000	20,000	70,000
Suggested minimum correction:							
Sewage treatment plants	5	2	23,400	380,000	27,000	17,000	44,000
Required interceptors				240,000	11,000		11,000
Independent industrial							
Waste correction							
Total				620,000	38,000	17,000	55,000
Comparative cost:							
Primary treatment all waste				590,000	35,000	15,000	50,000
Secondary treatment all waste				760,000	50,000	25,000	75,000
As suggested				620,000	38,000	17,000	55,000

DESCRIPTION

The Hocking River drains 1,185 square miles of hilly country in southeastern Ohio and joins the Ohio River 15 miles below Parkersburg, W. Va. The populations of the urban communities and of the basin are shown below.

	Populations			
	1910	1920	1930	1940
Urban communities:				
Lancaster	13,093	14,706	18,716	21,940
Athens	5,463	6,418	7,252	7,696
Logan	4,850	5,493	6,080	6,177
Nelsonville	6,082	6,440	5,322	5,368
New Lexington	2,559	3,157	3,901	4,049
Glouster	2,527	3,140	2,903	2,903
Total basin:				
Rural	74,729	74,512	63,188	65,422
Urban	34,574	39,354	44,174	48,133
Total	109,303	113,866	107,362	113,555

The population has not increased appreciably during the past 30 years although the urban communities have grown.

Agriculture and coal mining are the principal occupations. The coal fields in this area were developed early and production has been declining for some time.

Water uses.—The Hocking is not considered a navigable stream. There are no hydroelectric developments. Three small dams at Coolville, Guysville, and Athens furnish power for small mills. The upper part of the basin is one of Ohio's noteworthy recreational areas but it depends more on its scenic caves and forests than on its streams for its popularity. A few tributaries not affected by mine drainage and parts of the main river are considered fairly good fishing streams.

Two flood-control reservoirs have been studied by the United States Engineer Department in connection with the authorized program for Ohio River flood control. These are near the mouth of the East Branch of Sunday Creek and of Clear Creek. Both would be relatively small since the drainage areas above them are only 32 and 84 square miles respectively.

PRESENTATION OF FIELD DATA

Figure Mu–1 shows the location and magnitude of each of the more important sources of pollution in the basin. Figure H–2 shows similar data and, in addition, laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Fifty-one thousand people are served by the 16 public water supplies. All but two of these are from underground sources and neither of the two surface supplies is subject to pollution. Table H–2 shows data on these surface supplies.

TABLE H–2.—*Hocking River Basin: Surface water supplies*

Municipality	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
Corning	Impounded and wells	62	FD	600	0.02
New Lexington	Impounded	110	FD	3,200	.11
Total [3]				3,800	.13

[1] Miles above mouth of Hocking River.
[2] FD=Coagulated, settled, filtered, chlorinated.
[3] Neither of these supplies is below community sewer outfalls.

Sewerage.—Table H–3 shows the sewered population at each of the more important sources of pollution. About 48,400 people are connected to sewers and about half of the sewage is treated before being discharged to the streams.

TABLE H–3.—*Hocking River Basin: Sources of significant pollution, including industrial waste expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Receiving stream	Miles above mouth of Hocking River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Athens	Hocking River	35	7,000	None	11,200	11,200
Athens State Hospital	do	35	2,000	do	2,000	2,000
Nelsonville	do	53	4,300	do	4,300	4,300
Logan	do	67	5,600	do	7,200	7,200
Lancaster [1]	do	89	20,000	Secondary	21,400	3,200
Glouster	Sunday Creek	56	2,000	None	2,000	2,000
Boys Industrial School	Arney Run	95	1,100	Primary	1,100	700
Bremen	Rush Creek	96	1,300	None	2,700	2,700
Somerset	Mud Run [2]	112	1,100	do	1,100	1,100
New Lexington	Little Rush Creek	110	2,700	Secondary	2,700	400
9 smaller sources			1,300	(3)	1,300	1,200
Total			48,400		57,000	36,000

[1] Sewage treatment plant under construction at time of laboratory survey.
[2] Also drains to Jonathan Creek, tributary of Muskingum River.
[3] 1 primary plant. No treatment at 8 other places.

Industrial wastes.—Two meat-packing houses, a brewery, a cheese factory, and a milk-receiving station are the only sources of industrial wastes in the basin. The brewery wastes are discharged to a municipal treatment plant and wastes from the milk-receiving station are treated on a trickling filter. The other wastes are discharged untreated.

Acid mine drainage damages many of the tributaries of the Hocking but does not affect the main stream. Most of the abandoned mines have been sealed to prevent further formation of acid. Figures are not available for the total acid load and the reduction through sealing, but the figures for the Muskingum and Hocking Basins together are shown in the Muskingum report.

PRESENTATION OF LABORATORY DATA

Analyses of water from the Hocking River and its tributaries were made at a trailer laboratory in October 1939 and April 1940, and at the *Kiski* laboratory during the period April–September 1940. Summaries of laboratory findings are presented in table H–7 (p. 480) and selected data are shown in table H–5. Coliform, dissolved-oxygen, and oxygen-demand results are shown in figures Mu–3, Mu–4, and Mu–5 (p. 446) on the basis of the most unfavorable monthly average where observations were for long periods and averages of one to three samples where sampling was for periods of less than a month.

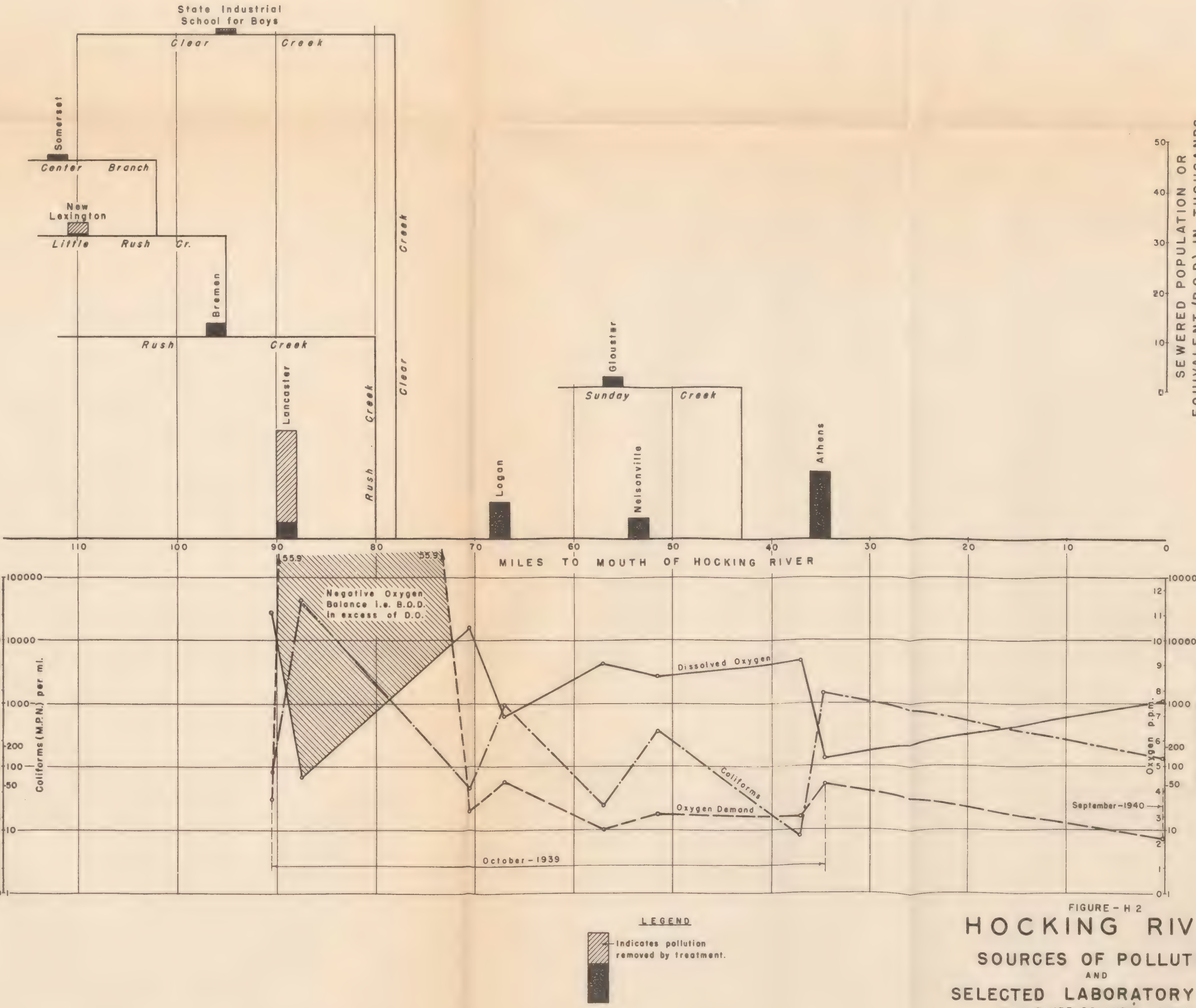


FIGURE - H 2
HOCKING RIVER
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

GPO-43 0-90035

TABLE H-5.—*Hocking River Basin: Selected laboratory data*

River	Hocking	Hocking	Hocking	Hocking	Hocking	Hocking
Location	Above Lancaster	Below Lancaster	Above Logan	Below Logan	Above Helson-ville	Below Nelson-ville
River miles above mouth of Hocking.	90.5	87.5	70.5	67	57	51.5
Period, 1939	October	October	October	October	October	October
Number of samples	5	3	3	3	3	3
Flow in cubic feet per second:						
Sampling days	8	9	52	52	65	65
Minimum month	12.2	12.2				
Water temperature, °C	9.8	11.2	9.3	8.8	9.5	9.5
Coliforms per milliliter	84	41,600	45	960	24	377
Dissolved oxygen, parts per million	11.1	3.7	10.5	7.0	9.1	8.6
Biochemical oxygen demand, 5-day, parts per million	4.6	55.9	3.2	4.4	2.5	3.1

River	Hocking	Hocking	Hocking	Little Rush Creek	Little Rush Creek	Little Rush Creek	Little Rush Creek
Location	Above Athens	Below Athens	At Hock-ingport	Above New Lexing-ton	Below New Lexing-ton	Above Bremen	Below Bremen
River miles above mouth of Hocking.	37	34.5	0.1	110.5	108.8	97	95
Period	August 1940	August 1940	August 1940	October 1939	October 1939	October 1939	October 1939
Number of samples	2	2	4	3	3	3	3
Flow in cubic feet per second:							
Sampling days	320	320	195	25	25	45	45
Minimum month	36.1	36.1					
Water temperature, °C	22.8	23.3	25.4	6.7	7.3	10.5	10.3
Coliforms per milliliter	68	5,850	127	1	113	24	530
Dissolved oxygen, parts per million	7.8	6.7	7.6	11.4	11.2	8.5	6.7
Biochemical oxygen demand, 5-day, parts per million	1.7	3.9	2.1	3.3	7.0	2.1	4.7

The laboratory observations indicate that the major pollution problems in this basin occur below Lancaster, Logan, and Athens, with acid wastes complicating the problem below New Lexington and on Sunday and Monday Creeks. The dissolved oxygen in the streams at the times of sampling generally averaged over 6.5 parts per million at most of the points. The lowest observed dissolved oxygen was 1.2 parts per million below Corning and averages of 3.5 to 4.5 parts per million were observed at Murray City and Lancaster. The coliform observations generally revealed more unfavorable pollutional conditions than did the dissolved-oxygen results. The results on Sunday and Monday Creeks are influenced by the acid conditions of these waters.

The biochemical-oxygen-demand results were generally below 3.0 parts per million. Even below sources of pollution it did not exceed 5.0 parts per million except in a few instances. The highest average was 56 parts per million below Lancaster. The oxygen-demand samples from those areas affected by acid drainage were neutralized and seeded to obtain an indication of the behavior of the oxygen demand under more normal conditions. These results are shown in table H-7 along with the other data. The oxygen demand of these acid waters was usually quite low and both the neutralized and unneutralized samples gave results of the same order of magnitude, as a rule. Where this was not so, the unneutralized samples usually gave the higher results, as might be expected where ferrous iron may

be present. Acid conditions were found at New Lexington on Little Rush Creek, Shawnee, New Straitsville, and Murray City on Monday Creek, and Corning, Glouster, and Jacksonville on Sunday Creek. pH values as low as 2.5 were found and phenolphthalein acidities as high as 1,400 parts per million. The pH values were within a range of 7.0 to 8.0 except where acid wastes were present. Alkalinity and hardness values in the normal streams were in the range of 100 to 200 parts per million.

Coliform counts observed above most communities were reasonably low, except above Lancaster, Haydenville, Corning, and Athens, There is some evidence of self-purification in the reduction of coliforms from Lancaster to Logan, from Haydenville to Nelsonville and from Nelsonville to Athens along the main stream, although in the last-mentioned stretch it is not as well marked as in the other two.

Biological summary.—The flora and fauna of the Hocking were found to be comparatively low. The plankton volume was not more than 5,000 parts per million and the fish population consisted of only a few species and numbers. Sunday and Monday Creeks were found to be too acid to support aquatic life.

Hydrometric Data

Three stream gaging stations have been maintained on the Hocking River, two of which are currently in operation. Table II–6 shows monthly mean summer flows during the driest years of record at all three of the stations:

TABLE II–6.—*Hocking River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Hocking	Hocking	Hocking
Location	Lancaster, Ohio	Enterprise, Ohio	Athens, Ohio
River miles above mouth of Hocking River	89	72	35
Drainage area (square miles)	92.8	460	944
Period of record	1923–32	1931–40	1915–40
Year	1930	1936	1930
June, cubic feet per second	19.8	68.1	77.8
July, do	12.5	88.7	52.2
August, do	12.2	98.1	39.6
September, do	15.9	36.3	44.8
Year	1925	1932	1925
June, cubic feet per second	26.6	112	128
July, do	29.8	256	314
August, do	56.3	39.9	191
September, do	12.3	57.2	51.6
Year	1932	1939	1936
June, cubic feet per second	45.9	322	110
July, do	85.8	183	109
August, do	17.3	140	116
September, do	15.1	40.3	58

Discussion

The Hocking River is not heavily polluted. The largest sources of untreated organic wastes, Athens, Logan, and Nelsonville, are on the main stream where stream flows are generally sufficient to prevent gross nuisances from their discharge. Primary treatment should be

sufficient to maintain good stream conditions at these points at all times. At Glouster the receiving stream is acid and, although discharges become very low, the provision of secondary treatment does not seem justified. At Bremen and Somerset, secondary treatment probably will be necessary because of the small size of the receiving streams. The treatment plant at the State Industrial School for Boys is inadequately designed and should be rebuilt. Industrial wastes can be treated at the municipal plants.

Further reduction in acid mine drainage can be effected by a renewal of the mine-sealing program. A high degree of restoration of acid streams may be delayed until mine-sealing activities are modified to bring worked-out sections of active mines under control.

Increased low flows from the proposed flood-control reservoirs would be desirable but would have no appreciable tangible benefits. The estimated cost of the suggested pollution abatement program is summarized in table H-1.

90035—44—pt. 2——22

TABLE H-7.—*Hocking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Hocking River, 1 mile above Lancaster, Ohio.	Ho 90.5	Oct. 18, 1940	6	9.0	13.3	114.8	3.3	46	8.2	58	206	231
Do	do	Oct. 23, 1940	6	9.5	11.1	96.9	6.4	46	8.0	93	240	
Do	do	Oct. 25, 1940	1	12.5	9.2	86.0	6.2	110	7.9	70	252	
Do	do	Oct. 30, 1940	11	7.5	11.4	95.0	2.2	110	8.1	39	240	165
Do	do	Oct. 31, 1940	9	10.5	10.4	93.0	.3	110	8.3	53	243	
Hocking River, ⅛ mile below Lancaster, Ohio.	Ho 87.5	Oct. 25, 1940	6	13.0	1.7	16.3	130.0	43,000	7.3	109	200	
Do	do	Oct. 30, 1940	11	9.0	7.0	60.3	11.8	39,000	7.5	18	266	175
Do	do	Oct. 31, 1940	9	11.5	5.2	47.6	26.0	43,000	7.8	21	288	
Little Rush Creek, ⅛ mile above New Lexington, Ohio.	HoLr 110.5	Oct. 20, 1940	2	14.5	7.7	75.2	5.8	(2)	2.9	10		
Do	do	Oct. 30, 1940	3	4.5	12.6	96.8	2.7	2	2.8	3.		344
Do	do	Nov. 3, 1940	2	1.0	14.1	99.0	1.2	(2)	2.9	8		445
Little Rush Creek, 1⅛ miles below New Lexington, Ohio.	HoLr 108.8	Oct. 20, 1940	2	15.0	10.0	98.7	7.7	240	3.9	28		
Do	do	Oct. 30, 1940	3	6.0	11.6	93.0	4.9	93	3.6	46		375
Do	do	Nov. 3, 1940	2	1.0	12.0	84.1	8.4	7	3.9	29		478
Rush Creek Bridge, U S 22, Somerset, Ohio.	HoR 110	May 2, 1940	2	8.0	12.5	105.4	.9	4	7.3		54	
Do	do	May 3, 1940	1	6.5	12.0	97.2	.8	4	7.4			
Do	do	May 6, 1940	1	14.5	11.3	110.0	1.1	8	7.5			
Rush Creek, side road 1 mile below Somerset, Ohio.	HoR 109	May 2, 1940	2	7.5	14.1	117.4	1.6	24	7.4		57	
Do	do	May 3, 1940	1	7.5	12.4	103.3	.8	24	7.5	8		130
Do	do	May 6, 1940	1	13.0	11.9	112.1	1.8	24	7.5	7		96
Little Rush Creek, 1 mile above Bremen, Ohio.	HoLR 97	Oct. 25, 1939	15	11.0	7.9	71.0	2.5	2	7.6	10	255	
Do	do	Oct. 27, 1929	98	13.5	7.9	75.7	1.5	23	7.6	77	173	
Do	do	Oct. 31, 1939	21	7.0	9.7	79.8	2.4	46	7.5	36	157	423
Little Rush Creek, 1 mile below Bremen, Ohio.	HoLR 95	Oct. 25, 1939	15	11.5	5.0	46.0	9.8	930	7.3	22	197	
Do	do	Oct. 27, 1939	98	13.0	6.9	65.1	2.1	230	7.4	84	180	
Do	do	Oct. 31, 1939	21	6.5	8.2	66.6	2.1	430	7.1	32	91	407
Hocking River, 1½ miles west of Logan, Ohio.	Ho 70.5	Oct. 18, 1939	45	9.0	11.4	98.0	2.9	15	7.9	26	208	203
Do	do	Oct. 23, 1939	44	11.0	10.4	94.0	3.2	9	7.8	10	210	
Do	do	Oct. 31, 1939	68	8.0	9.7	81.6	3.5	110	7.5	37	136	

Hocking River, 1½ miles below Logan, Ohio.	Ho 67.0	Oct. 18, 1939	45	8.0	7.2	60.6	3.9	2,400	7.6	24	213	201
Do	do	Oct. 23, 1939	44	10.5	5.6	49.7	4.6	240	7.6	10	205	
Do	do	Oct. 31, 1939	68	8.0	8.4	70.4	4.8	240	7.4	46	125	
Hocking River, 1,000 feet above sewer, Haydenville, Ohio.	Ho 62.0	Apr. 23, 1940	2,180	9.5	9.8	85.8	2.6	93	6.7		64	
Do	do	Apr. 25, 1940	1,060	10.0	9.6	85.1	1.9	240	7.4		96	
Do	do	Apr. 26, 1940	854	11.0	9.5	86.1	1.4	93	7.5		98	
Hocking River, ¼ mile above Haydenville, Ohio.	Ho 62.0	May 29, 1940	475	17.0	9.1	93.4	2.1	110	7.0	30	111	
Do	do	June 7, 1940	316	23.0	8.8	101.0	.9	43	7.5	17	128	
Do	do	June 18, 1940	502	23.5	7.6	87.9	1.8	460	7.5	155	103	
Do	do	June 26, 1940	258	19.0	7.6	80.9	1.3	430	7.3	102	108	
Hocking River, ¼ mile above Haydenville, Ohio.	Ho 62.0	July 5, 1940	167	20.0	8.1	88.2	1.2	230	7.5	85	141	
Do	do	July 15, 1940	102	21.0	7.9	87.9	2.1	240	7.7	55	142	
Do	do	July 23, 1940	169	28.0	8.6	108.4	3.6	91	8.0	15	180	
Do	do	July 31, 1940	81	27.0	7.8	97.0	3.4	460	7.7	19	162	
Do	do	Aug. 8, 1940	114	22.5	5.9	67.5	3.8	240	7.6	490	102	
Do	do	Aug. 26, 1940		21.0	6.0	67.2	2.2	430	7.4	110	163	
Do	do	Sept. 3, 1940		20.0	7.8	84.5	1.1	230	7.1	101	114	
Do	do	Sept. 11, 1940		20.5	8.2	90.9	1.0	24	7.3	13	106	
Do	do	Jan. 24, 1941		2.0	12.9	92.9	2.1	110	7.4	110	84	
Hocking River, below sewers, Haydenville, Ohio.	Ho 61.8	Apr. 23, 1940	2,180	10.5	9.8	87.4	1.8	240	6.7		67	
Do	do	Apr. 25, 1940	1,060	10.0	9.7	85.9	1.6	230	7.4		91	
Do	do	Apr. 26, 1940	854	11.5	9.6	87.3	1.7	36	7.6		107	
Hocking River, 1 mile below Haydenville, Ohio.	Ho 61.0	May 29, 1940	475	17.0	9.2	94.3	.9	110	7.2	25	111	
Do	do	June 7, 1940	316	23.5	7.6	88.0	.7	43	7.7	18	108	
Do	do	June 18, 1940	502	23.0	7.3	83.7	2.4	1,100	7.6	260	95	
Do	do	June 26, 1940	258	19.0	7.3	78.5	1.3	460	7.4	122	105	
Do	do	July 5, 1940	167	19.0	8.1	86.7	.9	140	7.5	101	140	
Do	do	July 15, 1940	102	21.0	7.6	84.4	1.9	430	7.7	58	142	
Do	do	July 23, 1940	169	27.5	8.3	104.4	2.7	36	7.9	15	177	
Do	do	July 31, 1940	81	27.0	7.3	91.0	2.2	43	7.9	23	156	
Do	do	Aug. 8, 1940	114	22.0	5.9	67.0	4.1	240	7.7	440	106	
Do	do	Aug. 26, 1940		21.0	7.4	81.8	2.0	460	7.4	95	139	
Do	do	Sept. 3, 1940		20.0	7.6	82.9	1.2	460	7.2	96	107	
Do	do	Sept. 11, 1940		19.0	7.4	79.6	1.9	930	7.3	12	107	
Do	do	Jan. 24, 1941		1.5	12.9	92.1	2.2	150	7.5	100	81	
Hocking River, 1½ miles above Nelsonville, Ohio.	Ho 57.0	Oct. 20, 1939	45	11.0	9.2	82.8	1.9	24	7.9	25	200	
Do	do	Oct. 25, 1939	47	11.5	9.4	86.0	2.3	2	7.5	7	203	
Do	do	Oct. 30, 1939	103	6.0	8.8	70.7	3.2	46	7.4	68	69	165
Hocking River, 1 mile below Nelsonville, Ohio.	Ho 51.5	Oct. 20, 1939	45	11.0	8.7	78.8	2.2	460	7.8	5	200	
Do	do	Oct. 25, 1939	47	12.0	8.4	77.9	3.2	430	7.7	7	224	
Do	do	Oct. 30, 1939	103	5.5	8.6	68.2	3.8	240	7.3	71	65	169

[1] Seeded and neutralized.
[2] Less than 1.

TABLE H-7.—*Hocking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Shawnee Creek, 3 miles above Shawnee, Ohio.	HoMnSh 72.5	May 28, 1940	2	18.0	9.1	95.6	.3		3.4	2		
Do	do	June 6, 1940	2	17.0	8.7	89.6	.3	(2)	3.5			
Do	do	June 17, 1940	2	17.5	7.7	79.9	2.3; [1]2.3	11	3.7	67		
Do	do	June 25, 1940	2	17.0	9.1	93.0	.3; [1].7	4	3.5	1		
Do	do	July 3, 1940	1	17.0	9.4	96.8	.4; [1].4	(2)	3.4			
Do	do	July 12, 1940	1	17.0	8.8	90.1	.4; [1]1.4	(2)	3.2	9		
Do	do	July 22, 1940	(2)	23.0	8.0	91.8	.2; [1].4	(2)	3.5	6		
Do	do	July 30, 1940	(2)	22.0	7.3	82.5	.7; [1].5	(2)	3.5			
Do	do	Aug. 7, 1940	1	20.5	8.2	90.8	.8; [1]1.2	(2)	3.5			
Do	do	Aug. 15, 1940	(2)	22.0	7.4	83.4	.6	5	3.5			
Do	do	Aug. 23, 1940		17.5	7.8	80.4	.1; [1].8	2	3.3	2		
Do	do	Sept. 10, 1940		18.0	7.1	74.0	.7; [1].8	11	3.3	6		
Do	do	Jan. 23, 1941		5.0	11.4	89.2	.4; [1].9	(2)	4.0	6		
Shawnee Creek, ¼ mile above Shawnee, Ohio.	HoMnSh 70	Apr. 25, 1940	2	9.5	10.2	89.3	1.0; [1]2.7	240	4.4			
Do	do	Apr. 26, 1940	1	9.5	10.2	88.8	1.6	4,600	4.5			
Do	do	Apr. 29, 1940	1	8.0	10.0	84.5	1.8; [1]1.4	36	4.1			
Shawnee Creek, ¼ mile below Shawnee, Ohio.	HoMnSh 68	Apr. 25, 1940	2	10.5	10.1	89.8	[1].7	2	4.6	18		1,460
Do	do	Apr. 26, 1940	1	11.5	10.3	93.6	.4	4	4.6	15		1,470
Do	do	Apr. 29, 1940	1	8.5	10.4	88.8	1.4	(2)	4.5	20		1,859
Shawnee Creek, 9 miles below Shawnee, Ohio.	do	May 28, 1940	2	19.0	8.3	88.9	1.5	24	4.1	12		
Do	do	June 6, 1940	2	19.5	8.0	86.4	.6	15	4.3	3		

Do	do	June 17, 1940	2	19.5	8.5	92.0	2.8; [1] 3.4	21	4.3	65		
Do	do	June 25, 1940	2	20.0	8.8	95.7	1.6; [1] 2.0		4.4	8		
Do	do	July 3, 1940	1	16.5	9.7	98.7	1.3; [1] 1.6	1,100	6.4	200		
Do	do	July 12, 1940	1	17.0	9.2	94.1	.6; [1] .9	230	5.3	18		
Do	do	July 22, 1940	(2)	22.5	8.5	96.9	.3; [1] .6	930	6.2	11		
Do	do	July 30, 1940	(2)	21.0	7.9	87.7	[1] 1.0	230	5.9	9		
Do	do	Aug. 7, 1940	1	19.5	8.5	91.6	1.0; [1] 1.5	1,100	6.1	7		
Do	do	Aug. 15, 1940	(2)	21.0	8.0	88.8	[1] 1.1	230	6.1	7		
Do	do	Aug. 23, 1940		16.5	8.8	88.8	.5; [1] 1.0	93	5.6	7		
Do	do	Sept. 10, 1940		18.0	7.7	80.8	1.0; [1] .8	43	4.4	7		
Do	do	Jan. 23, 1941		5.0	12.3	96.1	1.1; [1] 1.1	4	4.7	40		
Sugar Creek, ¼ mile above New Straitsville, Ohio.	HoMnSu 67.5	Apr. 23, 1940	4	9.5	10.2	89.4	1.8; [1] 1.7	(2)	3.4			
Do	do	Apr. 25, 1940	2	9.5	9.9	86.4	2.4; [1] 1.3	(2)	3.5			
Do	do	Apr. 26, 1940	2	10.5	11.3	100.7	1.5; [1] .6	(2)	3.3			
Sugar Creek, 3 miles above New Straitsville, Ohio.	do	May 28, 1940	2	19.0	11.0	117.3	4.5	2	3.3	1		
Do	do	June 6, 1940	1	25.0	8.3	98.5	.5	4	3.6	4		
Do	do	June 17, 1940	1	20.0	9.5	103.3	2.7; [1] 1.3	110	3.7	5		
Do	do	June 25, 1940	1	22.5	9.5	108.6	.9; [1] 2.2		3.6	6		
Do	do	July 3, 1940	(2)	19.0	8.9	95.0	[1] 1.3	12	3.7	10		
Do	do	July 12, 1940	1	19.5	8.7	94.1	.7; [1] 1.4	46	3.4	9		
Do	do	July 22, 1940	(2)	26.0	7.7	93.2	.3; [1] .9	23	3.7	8		
Do	do	July 30, 1940	(2)	25.0	7.6	90.9	.7; [1] .0	46	3.7	11		
Do	do	Aug. 7, 1940	(2)	20.5	8.9	98.0	2.4; [1] 1.0	4	3.7	6		
Do	do	Aug. 15, 1940	(2)	22.0	7.9	89.8	.6; [1] .7	8	3.7	2		
Do	do	Aug. 23, 1940		18.0	9.1	95.7	1.8; [1] 1.4	46	3.5	19		
Do	do	Sept. 10, 1940		17.5	8.0	83.0	.7; [1] .7	46	3.3	6		
Do	do	Jan. 23, 1941		6.0	11.5	92.0	1.0; [1] .3	150	3.7	5		

[1] Seeded and neutralized.
[2] Less than 1.

TABLE H-7.—*Hocking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*— Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Sugar Creek, city limits below New Straitsville, Ohio.	HoMnSu 65.5	Apr. 23, 1940	4	10.0	10.2	89.7	1.9 [1] 3.5	4	3.8	22		1,390
Do	do	Apr. 25, 1940	2	10.0	10.1	88.9	1.3 [1] 1.2	(2)	3.4	8		650
Do	do	Apr. 26, 1940	2	10.0	11.2	98.7	2.5 [1] .7	(2)	3.5	5		700
Sugar Creek, 1 mile below New Straitsville, Ohio.	HoMnSu 64.5	May 28, 1940	2	19.5	8.1	87.8	7.0	(2)	2.9	7		
Do	do	June 6, 1940	1	21.5	8.7	98.1	1.2	(2)	3.2	24		
Do	do	June 17, 1940	1	20.0	9.4	103.0	4.1 [1] 3.9	11	3.4	62		
Do	do	June 25, 1940	1	23.0	9.9	113.7	1.0 [1] 1.0		3.2	6		
Do	do	July 3, 1940	(2)	20.0	8.9	97.4	2.1 [1] 2.4	(2)	3.2	7		
Do	do	July 12, 1940	1	19.5	9.1	98.4	.4	11	2.9	6		
Do	do	July 22, 1940	(2)	27.5	8.9	111.3	1.3 [1] .8		3.2	4		
Do	do	July 30, 1940	(2)	26.0	8.4	101.5	.7 [1] .1	1	3.5	3		
Do	do	Aug. 7, 1940	(2)	22.5	8.0	91.2	1.1 [1] .5	2	3.5	2		
Do	do	Aug. 15, 1940	(2)	24.0	8.1	95.0	.3 [1] .6	2	3.5	3		
Sugar Creek, 1 mile below New Straitsville, Ohio.	HoMnSu 64.5	Aug. 23, 1940		18.0	9.8	102.6	1.6 [1] .9	2	3.4			
Do	do	Sept. 10, 1940		19.0	8.3	88.8	1.1 [1] .7	11	3.0	4		
Do	do	Jan. 23, 1941		4.0	12.3	93.5	1.0 [1] 1.1	(2)	3.4	6		
Red Fork Creek, 1 mile above Murray City, Ohio.	HoMnRf 57.5	Apr. 23, 1940	37	6.5	11.2	91.0	3.2 [1] 1.0	(2)	3.5			
Do	do	Apr. 25, 1940	21	8.5	9.2	78.8	6.0 [1] 1.5	(2)	3.2			570
Do	do	Apr. 26, 1940	17	7.5	11.3	94.2	2.4 [1] .5	(2)	3.5	35		

Red Fork Creek, city limits below Murray City, Ohio.	HoMnRf 55.0	Apr. 23, 1940	37	8.0	10.9	91.7	4.9; [1] 1.6	4	3.5			556
Do	do	Apr. 25, 1940	21	10.0	8.8	77.7	5.5; [1] 2.8	(2)	3.2	50		
Do	do	Apr. 26, 1940	17	9.0	10.6	91.6	4.8; [1] .4	(2)	3.5			480
Snow Creek, 2 miles above Murray City, Ohio.	HoMnSw 56.5	May 28, 1940	10	17.5	3.5	36.4	1.2		3.0	10		
Do	do	June 6, 1940	12	19.5	10.3	111.6			3.1	13		
Do	do	June 17, 1940	9	17.5	9.8	101.5	4.2; [1] .1	(2)	3.0	85		
Do	do	June 25, 1940	8	19.0	9.6	102.9	3.0; [1] 1.3	(2)	2.9	28		
Do	do	July 3, 1940	2	17.0	8.6	88.2	2.2; [1] .3		2.8	48		
Do	do	July 12, 1940	6	18.0	8.4	87.7	1.2; [1] .5		2.5	20		
Do	do	July 22, 1940	(2)	20.5	8.2	90.4	1.0; [1] .4		2.8	7		
Do	do	July 30, 1940	1	22.0	8.4	91.7	.7; [1] .4		3.1	5		
Do	do	Aug. 7, 1940	2	20.0	9.0	98.4	.4; [1] .6		2.9			
Do	do	Aug. 15, 1940	1	21.5	8.2	92.1	.8; [1] .4		2.9	4		
Do	do	Aug. 23, 1940		18.0	9.4	98.5	.8; [1] .8		2.6			
Do	do	Sept. 10, 1940		18.0	8.5	89.1	1.1; [1] 1.1		2.5	4		
Do	do	Jan. 23, 1941		4.5	12.9	99.6	2.6; [1] .6	0	4.4	22		
Snow Creek, 1 mile below Murray City, Ohio.	HoMnSw 54	May 28, 1940	10	17.0	5.7	58.3	1.0		2.8	24		
Do	do	June 6, 1940	12	21.5	10.2	114.1	.5		2.9	12		
Do	do	June 17, 1940	9	20.0	8.9	97.4	4.8; [1] .6		2.8	12		
Do	do	June 25, 1940	8	22.0	9.0	102.4	5.7; [1] .7	2	2.8	5		
Do	do	July 3, 1940	2	20.5	8.4	92.2	2.9; [1] 1.3		2.7	5		
Do	do	July 12, 1940	6	20.0	7.6	83.3	2.6; [1] 1.2	(2)	2.5	5		
Do	do	July 22, 1940	(2)	22.5	7.1	81.5	1.9; [1] .4		2.7	6		
Do	do	July 30, 1940	1	26.0	7.3	88.7	2.4; [1] .6		3.0	3		
Do	do	Aug. 7, 1940	2	23.5	7.5	86.7	1.5; [1] 1.2		2.9	2		
Do	do	Aug. 15, 1940	1	23.5	6.7	78.2	1.3; [1] .9		2.8	2		

[1] Seeded and neutralized.
[2] Less than 1.

TABLE H-7.—*Hocking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Snow Creek, 1 mile below Murray City, Ohio.	HoMnSw 54	Aug. 23, 1940		19.0	7.4	78.6	1.5 [1].7		2.6			
Do	do	Sept. 10, 1940		20.0	8.6	94.0	2.6 [1]1.2		2.5	4		
Do	do	Jan. 23, 1941		4.0	12.5	95.1	2.0 [1].6	24	3.6	30		
Town Creek, city limits above Corning, Ohio.	HoSnTn 65	Apr. 16, 1940	38	8.5	10.8	92.2	1.7 [1]2.8	(²)	6.0			
Do	do	Apr. 18, 1940	69	13.0	10.2	96.6	1.1	4	7.1		11	
Do	do	Apr. 24, 1940	20	8.0	10.8	90.6	1.6	2	6.7			
Town Creek, city limits below Corning, Ohio.	HoSnTn 63	Apr. 16, 1940	38	7.0	10.6	87.1	1.0 [1]1.2	46	6.1	42		196
Do	do	Apr. 18, 1940	69	13.5	8.9	84.9	1.0	15	6.6	85	8	
Do	do	Apr. 24, 1940	20	9.5	11.2	98.2	.3	4	5.2	72	9	410
Sunday Creek, 0.4 mile above Corning, Ohio.	HoSn 65	May 28, 1940	6	14.0	10.2	98.0	.6	2	7.0	2	57	
Do	do	June 6, 1940	8	20.0	8.7	94.3	.4	110	7.1		59	
Do	do	June 17, 1940	6	21.0	8.0	88.5	1.3	460	7.4	32	65	
Do	do	June 25, 1940	5	19.0	8.5	90.9	1.0	110	7.0	92	65	
Do	do	July 3, 1940	2	18.0	9.2	96.3	.6	150	7.5	13	74	
Do	do	July 12, 1940	1	19.5	7.6	82.2	2.6	1,100	6.7	350	61	
Do	do	July 22, 1940	(²)	22.0	5.2	58.7	1.5		7.2	20	20	
Do	do	July 30, 1940	(²)	24.5	6.7	79.2	.9	15	7.1	7	75	
Do	do	Aug. 7, 1940	(²)	20.5	7.3	80.3	1.3	110	6.9	12	49	
Do	do	Aug. 15, 1940	1	23.0	4.4	50.3	2.7	1,100	6.8	24	71	
Do	do	Aug. 23, 1940		18.5	8.3	87.7	2.0	91	6.7	27	65	
Do	do	Sept. 10, 1940		18.5	7.6	80.7	.8	210	7.1	5	82	
Do	do	Jan. 23, 1941		2.5	13.4	97.8	.6	93	7.0	24	45	
Sunday Creek, 1.5 miles below Corning, Ohio.	HoSn 63	May 28, 1940	6	14.0	1.2	11.9	1.0	(²)	4.4	25		
Do	do	June 6, 1940	8	18.0	8.8	92.3	.2	46	3.7	23		
Do	do	June 17, 1940	6	19.5	6.4	69.1	7.9 [1].4	93	3.6	60		
Do	do	June 25, 1940	5	17.0	9.1	93.3	7.2 [1].1	9	3.9	17		
Do	do	July 3, 1940	2	16.0	7.4	74.3	7.1 [1]0	9	3.5	16		

Do	do	July 12, 1940	1	19.0	7.5	80.3	7.8 / [1].8	24	3.7	18	------	------
Do	do	July 22, 1940	(2)	22.0	4.3	48.9	6.2 / [1].4	------	3.0	40	------	------
Do	do	July 30, 1940	(2)	20.5	4.0	44.1	6.3 / [1]1.0	------	3.0	41	------	------
Do	do	Aug. 7, 1940	(2)	18.0	5.1	53.4	6.9 / [1]1.3	------	3.0	22	------	------
Do	do	Aug. 15, 1940	1	18.0	7.1	74.2	7.7	(2)	3.1	12	------	------
Do	do	Aug. 23, 1940	------	16.5	6.7	67.7	7.6 / [1].9	------	2.8	16	------	------
Do	do	Sept. 10, 1940	------	17.5	4.9	51.0	3.0 / [1]1.8	(2)	2.7	9	------	------
Do	do	Jan. 23, 1941	------	3.0	12.9	95.4	1.0	46	6.9	45	42	------
Sunday Creek, 1 mile above Glouster, Ohio.	HoSn 58	Oct. 20, 1939	13	12.5	12.1	112.9	7.7	(2)	2.9	12	------	------
Do	do	Oct. 26, 1939	10	15.5	11.5	114.4	4.1	(2)	3.2	60	------	------
Do	do	Nov. 3, 1939	9	1.0	9.9	69.8	2.7	(2)	4.8	20	------	414
Sunday Creek, ½ mile below Jacksonville, Ohio.	HoSn 52.5	Oct. 20, 1939	13	11.5	8.0	73.4	16.3	4	2.9	17	------	------
Do	do	Oct. 26, 1939	10	14.5	9.1	88.4	9.1	15	3.4	69	------	------
Do	do	Nov. 3, 1939	8	1.5	10.4	74.1	2.2	46	6.4	20	------	838
Hocking River, above city limits, Athens, Ohio.	Ho 37	Oct. 18, 1939	49	6.5	10.2	82.6	4.0	4	7.4	36	172	163
Do	do	Oct. 23, 1939	55	13.0	8.6	80.8	2.9	9	7.3	26	167	------
Do	do	Oct. 31, 1939	142	9.0	8.8	76.4	2.1	9	7.0	17	50	------
Do	do	Apr. 17, 1940	4,200	12.5	9.8	91.0	2.8	240	6.5	------	------	------
Do	do	Apr. 18, 1940	6,310	11.0	9.7	87.3	2.5	43	6.5	------	------	------
Do	do	Apr. 23, 1940	6,400	11.5	9.8	89.1	1.6	43	6.2	------	32	------
Do	do	Apr. 29, 1940	1,000	14.5	9.0	87.9	2.2	4	6.9	------	------	------
Do	do	May 29, 1940	699	17.0	8.6	88.6	.7	46	6.6	36	52	------
Do	do	June 7, 1940	571	23.0	7.5	86.1	.8	46	7.0	21	66	------
Do	do	June 18, 1940	1,110	23.0	7.9	91.0	.7	460	6.9	160	43	------
Do	do	June 26, 1940	421	19.9	8.0	85.1	.8	230	6.8	78	65	------
Do	do	July 5, 1940	252	20.0	8.0	87.5	.7	230	6.9	39	81	------
Do	do	July 15, 1940	148	22.0	8.4	94.9	1.3	3	7.3	8	98	------
Do	do	July 23, 1940	103	28.0	7.6	96.0	1.1	------	7.5	12	109	------
Do	do	July 31, 1940	114	28.0	6.5	82.2	.6	93	7.2	18	70	------
Do	do	Aug. 8, 1940	320	23.5	6.8	79.4	2.0	15	7.4	17	127	------
Do	do	Aug. 26, 1940	172	22.0	8.7	98.9	1.3	120	7.3	14	110	------
Do	do	Sept. 3, 1940	431	20.5	7.6	83.3	.4	23	6.7	41	55	------
Do	do	Sept. 11, 1940	157	17.0	7.6	78.1	1.2	460	7.2	24	66	------
Do	do	Jan. 24, 1941	2,460	4.0	13.1	99.5	.8	15	7.1	40	59	------
Hocking River, city limits, below Athens, Ohio.	Ho 34.5	Oct. 18, 1939	49	9.0	3.8	33.2	4.9	1,100	7.3	21	157	167
Do	do	Oct. 23, 1939	55	11.0	3.9	35.0	5.3	1,500	7.4	8	168	------
Do	do	Oct. 31, 1939	142	10.0	8.1	71.6	5.6	1,500	7.1	58	65	------
Do	do	Apr. 17, 1940	4,200	12.5	10.4	97.6	2.5	93	6.5	245	33	------
Do	do	Apr. 18, 1940	6,310	11.5	9.8	89.6	2.8	240	6.5	375	20	------
Do	do	Apr. 23, 1940	6,400	11.0	10.0	90.1	6	93	6.2	105	------	132

[1] Seeded anp neutralized.
[2] Less than 1.

TABLE H-7.—*Hocking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness parts per million
					Parts per million	Percent saturation						
Hocking River, city limits, below Athens, Ohio.	do	Apr. 29, 1940	1,000	14.0	9.6	92.6	1.4	23	7.1	110	32	230
Do	do	May 29, 1940	699	17.0	9.0	92.4	1.8	110	6.6	32	53	----------
Do	od	June 7, 1940	571	23.5	7.8	90.8	.7	240	7.5	12	67	----------
Do	do	June 18, 1940	1,110	23.0	7.6	88.1	1.6	930	7.2	180	62	----------
Do	do	June 26, 1940	421	20.0	7.9	86.5	.6	430	7.1	26	76	----------
Do	do	July 5, 1940	252	19.5	8.1	87.6	.8	200	7.0	23	67	----------
Do	do	July 15, 1940	148	21.5	7.3	82.3	2.4	750	7.4	10	104	----------
Do	do	July 23, 1940	103	27.5	5.2	65.4	1.6	930	7.5	8	107	----------
Do	do	July 31, 1940	114	27.5	5.4	67.9	1.0	1,500	7.3	12	81	----------
Do	do	Aug. 8, 1940	320	25.0	7.4	88.4	2.7	2,400	7.5	12	106	----------
Do	do	Aug. 26, 1940	172	21.5	6.0	67.4	5.0	9,300	7.4	375	96	----------
Do	do	Sept. 3, 1940	431	20.5	8.1	88.7	1.0	360	6.8	40	54	----------
Do	do	Sept. 11, 1940	157	17.0	8.0	81.6	1.3	240	7.3	16	167	----------
Do	do	Jan. 21, 1941	2,460	3.5	13.2	99.2	5.6	240	7.2	850	66	----------
Hocking River, Hockingport, Ohio	Ho 0.1	May 16, 1940	515	16.5	9.7	98.5	1.1	46	7.4	8	95	----------
Do	do	May 20, 1940	510	19.5	8.6	93.4	.9	15	7.4	5	87	----------
Do	do	May 22, 1940	408	20.5	8.3	91.4	1.0	9	7.1	23	86	----------
Do	do	May 28, 1940	1,010	17.0	9.1	93.0	.7	24	6.8	12	45	----------
Do	do	June 5, 1940	1,020	22.0	8.3	94.2	1.4	43	7.2	25	58	----------
Do	do	June 13, 1940	1,830	25.0	7.5	89.2	1.7	240	7.4	235	49	----------
Do	do	June 19, 1940	1,540	24.5	7.4	87.1	1.3	240	7.3	195	71	----------
Do	do	June 27, 1940	466	22.0	7.8	88.7	.9	7	7.2	23	78	----------
Do	do	July 3, 1940	490	22.0	7.8	87.9	.9	230	7.3	98	60	----------
Do	do	July 11, 1940	207	26.5	9.2	112.4	2.1	--------	7.4	12	117	----------
Do	do	July 17, 1940	169	24.0	8.2	96.4	1.4	9	7.4	17	50	----------
Do	do	July 25, 1940	1,470	27.5	6.5	80.8	2.9	93	7.5	290	100	----------
Do	do	July 31, 1940	143	28.5	6.6	83.8	1.1	9	7.4	75	68	----------
Do	do	Aug. 8, 1940	400	26.0	6.6	79.8	2.5	24	7.3	83	73	----------
Do	do	Aug. 14, 1940	89	28.0	7.2	91.0	1.8	9	7.7	17	139	----------
Do	do	Aug. 22, 1940	100	23.5	9.7	112.5	2.2	4	7.3	12	85	----------
Do	do	Aug. 28, 1940	1,940	24.0	7.0	82.3	1.9	460	7.1	255	93	----------
Do	do	Sept. 5, 1940	337	21.0	7.9	87.7	.5	23	6.9	21	67	----------
Do	do	Sept. 11, 1940	2,610	20.5	8.7	96.3	1.8	24	6.9	18	100	----------

[1] Seeded and neutralized.
[2] Less than 1.

KANAWHA RIVER BASIN

CONTENTS

	Page
Contents	491
Syllabus and conclusions	493
Description	495
Presentation of field data	496
Presentation of laboratory data	499
Hydrometric data	502
Discussion	505

LIST OF TABLES

K–1. Cost estimates of remedial measures	494
K–2. Surface water supplies	496
K–3. Sources of pollution	498
K–4. Industrial wastes	499
K–5. Selected laboratory data	500
K–6. Monthly mean summer flows	504
K–7. Summary of laboratory data	508

LIST OF FIGURES

K–1. Map—Sources of pollution	493
K–2. Chart—Sources of pollution and selected laboratory data	498
K–3. Map—Coliform results	500
K–4. Map—Dissolved oxygen results	500
K–5. Map—Biochemical oxygen demand results	500
K–6. Chart—Summer low-flow frequency curve	503

KANAWHA—LITTLE KANAWHA BASINS

SOURCES OF POLLUTION

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. K-1

(Face p. 403)

GPO-43 O-90035

KANAWHA RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Kanawha River drains 12,300 square miles of mountainous country in West Virginia, Virginia, and North Carolina. The area is rather sparsely settled except in the rapidly developing industrial area along the Kanawha River in the vicinity of Charleston, W Va. About 20 percent of the total basin population of 835,000 is urban and about one-sixth of the total population is in the metropolitan area of Charleston. Chemical plants in this section are the principal sources of pollution. Wastes from these and other industries and the untreated domestic sewage from Charleston and its satellites account for more than 90 percent of the pollution load in the basin. As a result, in part, of the Ohio River pollution survey, working in cooperation with the State water commission and the State health department, studies are being made by the industries to determine the most practicable methods for abating this pollution and limited corrective measures have already been taken. Acid mine drainage damages a number of the tributary streams in West Virginia, particularly those south of the Kanawha and New Rivers.

Most of the streams outside the Charleston area are relatively clean and, except in a few places, can be maintained in excellent condition by the adoption of available methods of waste treatment. This is particularly desirable because of the extensive use of the streams for recreation. Low-flow augmentation by reservoirs above Charleston would be a valuable supplement to waste treatment and recovery practices in correcting the organic constituents of the heavy industrial pollution in the Charleston area. Taste and odor characteristics will be improved to a lesser extent. Increased flow in the Elk River is desirable to insure the adequacy of Charleston's water supply.

The pollution abatement program in the Charleston area will involve sewage treatment and industrial waste correction. Because of the technical and often secret nature of the industrial processes involved, industrial pollution corrective measures are squarely up to the industries themselves.

CONCLUSIONS

(1) Sixty-five of the 180 public water supplies in the basin are from surface sources. Thirty-three of these, serving more than 150,000 people, are from streams subject to pollution.

(2) Sewage from more than 225,000 people and industrial wastes equivalent to sewage from an additional 1,490,000 enter the streams of the basin. Less than 25 percent of the municipal sewage is treated prior to its discharge.

(3) Laboratory studies indicate that except for the Kanawha in and below the Charleston area the larger streams are relatively clean. Several bad local situations were found on small tributaries.

(4) The major pollution problem in the basin, the reduction of industrial pollution in the Charleston area, is being studied by the industries and limited indicated corrective measures have already been taken. For several of the larger industries, this is a recent development resulting in part from studies by the Ohio River pollution survey working in conjunction with the State of West Virginia.

(5) Primary treatment of domestic sewage will be sufficient to maintain satisfactory conditions on the larger streams except in the Charleston area. More refined treatment cannot be justified in this area.

(6) Secondary treatment is justified at a number of the communities on small streams such as Princeton, Richwood, Pulaski, Wytheville, and White Sulphur Springs. The streams at these places are subject to extremely low flows.

(7) Low-flow augmentation by proposed flood-control reservoirs would improve conditions in the Charleston area. The Bluestone Reservoir, now under construction, will be particularly valuable because of the large increase in flow which it could provide.

(8) Because of the uncertainties in regard to details of reducing industrial pollution in the Charleston area, estimates of the cost of pollution abatement may be subject to correction. The following summary from table K–1 includes $1,270,000 for the capital cost and $240,000 for annual operation costs of industrial waste control, the bulk of which would be taken by the chemical plants around Charleston.

Treatment	Capital cost	Annual charges
Existing	$1, 300, 000	$115, 000
Suggested additional	6, 270, 000	815, 000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	$5, 890, 000	$770, 000
Secondary, all places	7, 190, 000	890, 000

Table K–1.—*Kanawha River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	6	6	49, 500	$1, 500, 000	$80, 000	$35, 000	$115, 000
Suggested minimum correction:							
Sewage-treatment plants	35	16	164, 400	2, 470, 000	175, 000	115, 000	290, 000
Required interceptors				2, 530, 000	120, 000		120, 000
Independent industrial waste correction				1, 270, 000	165, 000	240, 000	405, 000
Total				6, 270, 000	460, 000	355, 000	815, 000
Comparative cost:							
Primary treatment all waste				5, 890, 000	430, 000	340, 000	770, 000
Secondary treatment all waste				7, 190, 000	520, 000	370, 000	890, 000
As suggested				6. 270. 000	460. 000	355. 000	815. 000

Description

The Kanawha River is formed by the confluence of the New and Gauley Rivers at Gauley Bridge, W. Va., and flows in a northwesterly direction 97 miles to its junction with the Ohio at Point Pleasant, W. Va. It drains 12,300 square miles of mountainous country, of which 8,450 are in West Virginia, 3,080 in Virginia, and 770 in North Carolina. The principal tributaries are:

Tributary	Distance above mouth of Kanawha	Drainage area, square miles
Elk River	58	1,540
Gauley River	97	1,440
New River	97	6,920
Greenbrier River [1]	161	1,500

[1] Tributary of New River.

Seventeen municipalities in the basin have more than 2,500 population. Eleven are in West Virginia and the other 6 in Virginia. The populations of the larger communities and of the entire basin are shown below:

	Population			
	1910	1920	1930	1940
Principal cities:				
Charleston, W. Va	22,996	39,608	60,408	67,914
Bluefield, W. Va	11,188	15,282	19,339	20,641
Beckley, W. Va	2,161	4,149	9,357	12,852
South Charleston, W. Va	----------	3,650	5,904	10,377
Pulaski, Va	5,317	5,282	7,168	8,792
Princeton, W. Va	3,027	6,224	6,955	7,426
Radford, Va	4,202	4,627	6,227	6,990
Hinton, W. Va	3,656	3,912	6,654	5,815
Dunbar, W. Va	----------	----------	4,189	5,266
Richwood, W. Va	3,061	4,331	5,720	5,051
Entire basin:				
Rural	468,296	515,079	580,191	659,327
Urban	56,501	98,180	147,858	175,518
Total	524,797	613,259	728,049	834,845

The biggest concentration of population is in the Kanawha Valley in the vicinity of Charleston, W. Va. Three of the above communities (Charleston, South Charleston, and Dunbar) are in this area which has developed recently as a major organic chemical manufacturing center. Coal mining is an important industry, the most important coal fields being south of the Kanawha and New Rivers in West Virginia adjacent to the Guyandot and Big Sandy Basins. In the western part of the basin, oil, gas, and salt brines are produced. Agriculture is handicapped by the lack of level land except in the stream valleys. Forestry, formerly an important occupation, has decreased in importance due to the lack of forest conservation practices. Reforestation is now in progress on some of the timberland.

Water uses.—The lower 91 miles of the Kanawha have been made navigable for boats of 9-foot draft by the construction of three locks and dams. In 1939 about 4,000,000 tons of freight moved on the

river. Traffic has increased steadily since the completion of the 9-foot project in 1935.

There are 10 hydroelectric developments on the Kanawha and New Rivers, the most important ones being near Byllesby, Va. (mile 295), Radford, Va., and Gauley Bridge, W. Va. There are also some small water-power developments on tributaries. The Kanawha and New Rivers are among the best power streams in the Ohio Basin.

A number of reservoirs have been studied by the United States Engineer Department in connection with the authorized program for Ohio River flood control and one project, the Bluestone Reservoir, is under construction. This reservoir, on the New River above Hinton, would aid in flood control in the Kanawha Valley and, in addition, could provide a considerable amount of power and an increase in flow of more than 600 cubic feet per second during low-flow periods.

A large part of the basin is well suited for recreational uses. The New and most of its tributaries, in Virginia and North Carolina; the Greenbrier, the Gauley, the Elk and the Coal in West Virginia are all used extensively for fishing, swimming, and boating. There are a number of excellent trout streams. Use of the lower Kanawha River is limited almost entirely to boating because of gross pollution in the vicinity of Charleston.

Presentation of Field Data

Figure K–1 shows the location and magnitude of the more important sources of pollution in the basin. Figure K–2 shows similar data and, in addition, the location of water supply intakes from polluted streams and laboratory data on coliform organisms, dissolved oxygen and biochemical oxygen demand.

Public water supplies.—There are 180 public water supplies in the basin which serve more than 325,000 people. Sixty-five of these are from surface sources and about half of these are from streams subject to pollution. Table K–2 shows data on the surface supplies of the basin. Four of these supplies, those at Charleston, Belle, St. Albans, and Nitro, are owned by one company and are interconnected. They serve almost all of the communities in the most densely populated portion of the basin.

TABLE K–2.—*Kanawha River Basin: Surface water supplies*

Supply	State	Source	Mile[1]	Treatment[2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
Winfield	West Virginia	Kanawha River	32.3	FD	300	0.01
Nitro	do	do	44.2	FD	11,500	1.50
Belle	do	do	69.6	FD	9,000	.30
Chelyan	do	do	73.6	FD	800	.02
Cabin Creek	do	do	74.5	FD	100	.01
Cedar Grove	do	do	77.5	FD	1,600	.05
Pratt	do	do	81.0	FD	400	.02
Handley	do	do	83.3	F	500	.02
Montgomery	do	do	85.4	FD	3,200	.20
Harewood	do	do	88.0	FD	1,000	.05
Alloy	do	do	89.7	FD	1,600	.20

[1] Miles from mouth of Kanawha River.
[2] F=coagulated, settled, filtered, D=chlorinated.

TABLE K-2.—*Kanawha River Basin: Surface water supplies*—Continued

Supply	State	Source	Mile	Treatment	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
Charlton Heights	West Virginia	Kanawha, small stream.	93.0	FD [3]	100	0.01
Glen Ferris	do	Kanawha River	95.6	FD	400	.06
Brooklyn	do	New River	116.0	D	500	.01
Rush Run	do	do	119.0	D	200	.01
Radford	Virginia	do	244.0	FD	7,000	.38
Austinville	do	do	286.0	FD	400	.03
St. Albans	West Virginia	Coal River	46.4	FD	5,500	.25
Whitesville	do	do	102.0	D	800	.03
Madison	do	Pond Fork Coal River	92.1	FD	2,200	.07
Charleston	do	Elk River-Kanawha River.	61.4	FD	85,000	7.00
Clendenin	do	Elk River	79.2	FD	1,300	.09
Clay	do	do	110.5	FD	600	.05
Dundon	do	Elk River-Impounded.	110.5	FD	100	.02
Gassaway	do	Elk River	152.0	FD	1,400	.06
Sutton	do	do	158.0	FD	1,300	.08
Addison	do	Elk River, small stream.	197.5	FD	1,300	.05
Hinton	do	Greenbrier-New River	161.5	FD	7,000	.25
Alderson (Federal institution).	do	Greenbrier River	187.0	FD	700	.10
Alderson	do	do	190.0	FD	1,700	.10
Ronceverte	do	do	204.0	FD	2,300	.14
Lewisburg	do	do	208.0	FD	1,800	.15
Nemours	do	Bluestone River	225.5	FD	100	.01
Total:						
Below sewer outfalls					151,700	11.33
32 other surface supplies					49,800	3.76
Total surface water supplies					201,500	15.09

[3] Filtered, no coagulants.

The drought of 1930 caused serious damage to the quality of the Charleston water supply. An epidemic of approximately 9,000 cases of acute gastroenteritis occurred. During this time, septic conditions prevailed in the Elk River near the waterworks intake due to decomposing garbage and sewage. Bacteriological examinations of the filter plant effluent at the time showed the supply to be meeting the United States Treasury Department drinking-water standards. The Charleston supply has an emergency intake in the Kanawha River which was installed at that time and has not been used since.

The St. Albans supply from Coal River is affected at times by backwater from the Kanawha. The chemical quality of the surface water supplies of the basin is generally good. In addition to serving as a source of municipal water, the Kanawha River furnishes more than 800 million gallons per day for industrial uses.

Sewerage.—Slightly more than 225,000 people in the Kanawha Basin are served by sewers, almost 200,000 of whom are in West Virginia. About one-half of all the sewage comes from towns along the Kanawha River. Less than one-quarter of the sewage receives treatment prior to discharge. Two of the larger communities, Bluefield and Beckley, have recently installed sewage-treatment plants.

TABLE K-3.—*Kanawha River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	State	Receiving stream	Mile [1]	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Nitro	West Virginia	Kanawha River	43	4,000	None	334,000	334,000
St. Albans	do	Kanawha River-Coal River.	46	4,000	do	4,000	4,000
Dunbar	do	Kanawha River	52	5,200	do	5,200	5,200
South Charleston	do	do	54	9,000	do	787,000	787,000
Charleston	do	Kanawha River-Elk River.	58	70,000	do	70,000	70,000
Belle	do	Kanawha River	70	1,400	do	338,400	338,400
Montgomery	do	do	85	3,200	do	3,200	3,200
Hinton	do	New River-Greenbrier River.	159	6,700	do	6,700	6,700
Narrows	Virginia	New River-Wolf Creek.	197	300	do	2,900	2,900
Pearisburg	do	New River	203	400	do	7,000	7,000
Radford	do	do	242	2,100	do	3,800	3,800
Boone	North Carolina.	Winkler Creek	412	2,200	do	3,100	3,100
Falling Rock	West Virginia	Elk River	75			2,700	2,700
Richwood	do	Cherry River	168	4,200	None	4,200	4,200
Beckley	do	Piney Creek-Little Whitestick Creek.	146	14,500	Primary	14,600	9,500
White Sulphur Springs.	do	Howards Creek	215	2,800	do	2,800	1,800
Marlinton	do	Greenbrier River	268	1,600	None	7,500	7,500
Durbin	do	do	311	500	do	6,700	6,700
Princeton	do	Brush Creek	190	6,500	do	6,600	6,600
Bluefield	West Virginia and Virginia.	Bluestone River	234	19,500	Secondary	26,000	2,200
Bluefield	West Virginia	Grassy Branch of East River.	213	3,000	do	7,500	400
Blacksburg	Virginia	Strubles Creek	243	4,400	do	4,400	2,000
Pulaski	do	Peak Creek	253	5,000	None	8,600	8,600
Galax	do	Chestnut Creek	311	2,400	do	3,800	3,800
95 smaller sources				53,600		56,000	53,800
Total:							
West Virginia				199,800		1,671,700	1,633,600
Virginia				21,700		38,900	35,700
North Carolina				5,000		6,100	5,800
Total, basin				226,500		1,716,700	1,675,100

[1] Miles above mouth of Kanawha River.

Industrial wastes.—Table K-4 summarizes data on the sources of industrial wastes by type of industry and method of disposal. The population equivalent of the industrial wastes amounts to more than six times that of the sewage and all but about 3 percent of this load is discharged to the Kanawha River in the 25-mile stretch from Belle to Nitro (the Charleston metropolitan area).

In addition to these industries, there are 24 coal washeries, most of which have recirculating systems but from which varying amounts of fine coal particles escape causing turbidity and culm deposits in the streams.

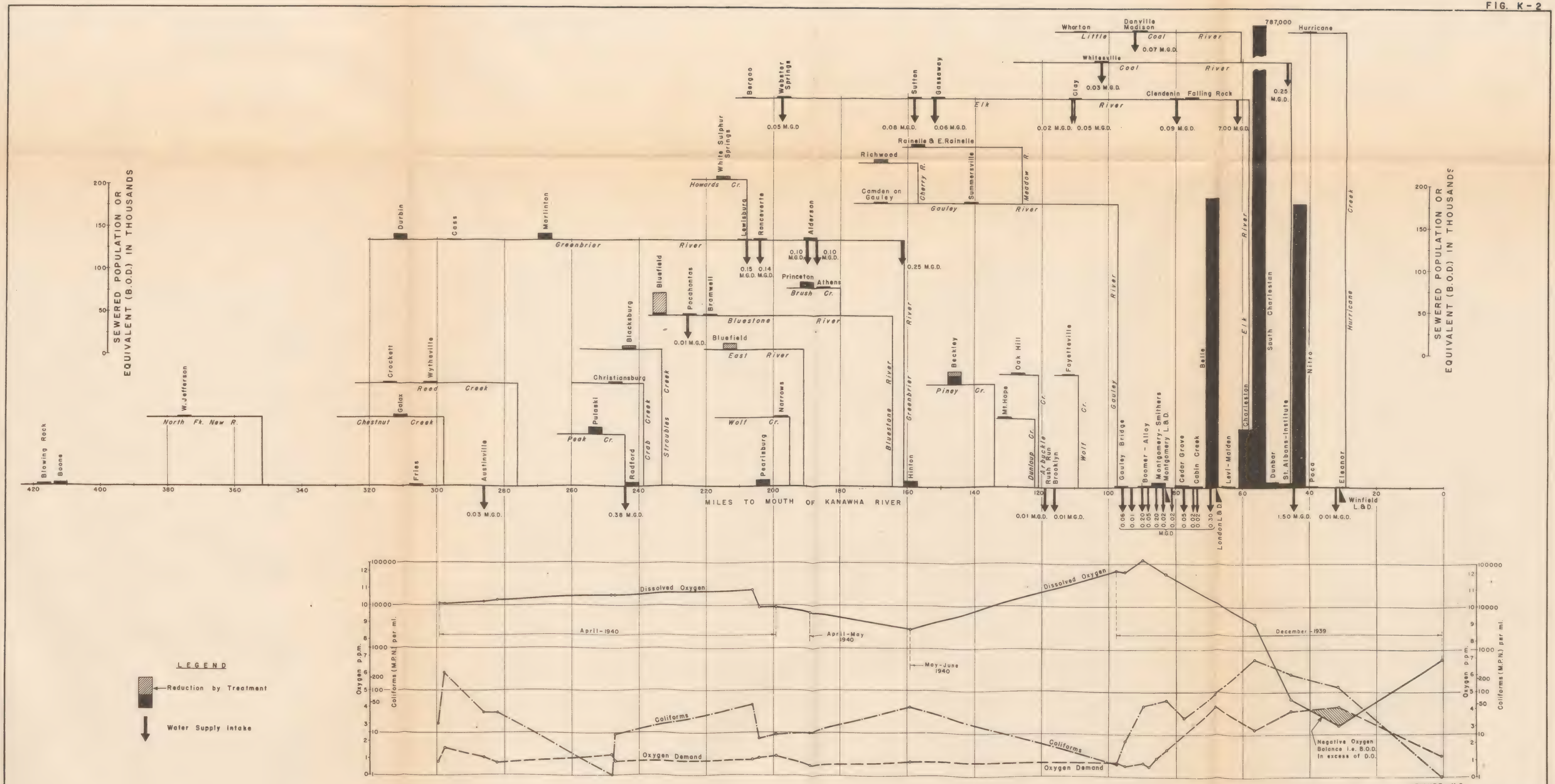


FIGURE - K 2
KANAWHA RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

 GPO-43 O-90035

TABLE K–4.—*Kanawha River Basin: Summary of industrial wastes not discharged to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal: Municipal sewers	Industrial waste disposal: Private outlets	At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
Canning	2		2	1	1,600
Chemical	11	3	8	4	1,378,000
Milk	2		2	2	200
Oil refining	2		2	2	3,600
Tanning	3		3	3	18,700
Textile	9	3	6	2	8,300
Miscellaneous	36	0	36	17	68,700
Wastes unconnected municipal treatment	65	6	59	31	1,479,100
Waste connected to municipal treatment					11,100
Total industrial waste in basin					1,490,200

Acid mine drainage.—Prior to the mine-sealing program some 33,000 tons of acid were discharged each year from about 950 mines. Mines producing about two-thirds of this acid have been sealed and the total acid load has been reduced by more than 40 percent. The acid from unsealed mines comes largely from active mines which discharge more than 9,000 tons per year. Most of the acid-producing mines are in the area drained by the Bluestone and along the small tributaries of the Kanawha and New Rivers in West Virginia.

PRESENTATION OF LABORATORY DATA

Table K–7 (p. 508) summarizes the results of the laboratory observations in the Kanawha Basin. Table K–5 shows selected laboratory data on the main stream and tributaries. All samples from the Kanawha Basin were collected and analyzed by a mobile laboratory unit except for those samples at the mouth, which were collected and analyzed at the *Kiski* Laboratory at Ashland. The various sampling periods involved in studying this basin were as follows:

Area	Period	Laboratory unit
Mouth	August 1939 to April 1940	*Kiski.*
Gauley Bridge to mouth	December 1939 to March 1940	Trailer.
New, Gauley and Greenbrier	April to June 1940	Do.
Taste and odors—Charleston	December 1939 to January 1940	Do.
Do	December 1940 to February 1941	Do.

TABLE K-5.—*Kanawha River Basin: Selected laboratory data*

River	Kanawha	Kanawha	Kanawha	Kanawha	Kanawha	Kanawha
Location	Near mouth	United States lock, Winfield	Bridge, St. Albans	Patrick St. Bridge, Charleston	Kanawha City Bridge, Charleston	United States lock, Belle
River miles above mouth of Kanawha.	0.6	31.1	45.6	56.3	60.9	67.7
Period	December 1939	December 1939	December 1939	December 1939	February 1941	December 1939
Number of samples	7	3	3	3	2	3
Flow in cubic feet per second, sampling days	3,260					
Water temperature °C	5.0	8.7	7.7	6.3	0.8	8.3
Coliforms per milliliter	[1]	124	257	577	29	72
Dissolved oxygen, parts per million	6.9	3.0	4.6	9.0	12.6	10.2
Biochemical oxygen demand, 5-day, parts per million	1.2	4.1	3.9	2.8	3.2	4.1

River	Kanawha	Kanawha	New	New	New	New	New
Location	United States lock, London	Below Gauley Bridge	Above mouth	Bridge at Hinton	Below Narrows	Above Pearisburg	Below bridge, Radford
River miles above mouth of Kanawha.	82.8	95	97.1	159	199	204	247
Period	December 1939	December 1939	December 1939	May–June 1940	April 1940	April 1940	April 1940
Number of samples	3	2	2	3	3	2	3
Flow in cubic feet per second:							
Sampling days				13,330		3,260	3,170
Minimum month		1,130	1,090	1,090			940
Water temperature °C	6.0	4.0	5.5	18.8	11.2	11.8	9.7
Coliforms per milliliter	62	7	2	41	9	7	9
Dissolved oxygen, parts per million	11.9	12.0	12.1	8.6	9.9	9.8	10.6
Biochemical oxygen demand, 5-day, parts per million	1.6	.6	.8	.8	1.1	1.0	.8

River	Peak Creek	Peak Creek	Stroubles Creek	Stroubles Creek	Brush Creek	Brush Creek	Bluestone
Location	Above Pulaski, Va.	Below Pulaski, Va.	Above Blacksburg, Va.	Below Blacksburg, Va.	Above Princeton, W. Va.	Below Princeton, W. Va.	Below Bluefield, Va.
River miles above:							
Confluence with New River	23.5	22	11	9	27	24.5	69.5
Mouth of Kanawha	268	266.5	244	242	191.5	189	215
Period, 1940	April	April	April	April	April and May	April and May	May
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	68	68	3	3	3	20	30
Minimum month	[1]	[1]	[1]	[1]			
Water temperature °C	9.0	10.3	12.8	13.2	14.2	13.7	13.5
Coliforms per milliliter	16	26	8	4,740	88	970	11
Dissolved oxygen, parts per million	10.8	8.1	10.1	7.4	9.4	5.5	9.0
Biochemical oxygen demand, 5-day, parts per million	.6	[2] 7.77	3.4	11.6	.6	2.4	3.0

KANAWHA—LITTLE KANAWHA BASINS
COLIFORM RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. K-3

(Face p. 500) No. 1 GPO-43 O-59035

KANAWHA—LITTLE KANAWHA BASINS

DISSOLVED OXYGEN RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. K-4

(Face p. 500) No. 2 GPO-43 O-90035

KANAWHA—LITTLE KANAWHA BASINS

BIOCHEMICAL OXYGEN DEMAND

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. K-5

(Face p. 500) No. 3 GPO-43 O-98035

TABLE K–5.—*Kanawha River Basin: Selected laboratory data*—Continued

River	Greenbrier	Greenbrier	Piney Creek	Piney Creek	Cherry	Cherry	Elk
Location	Above Marlinton, W. Va.	Below Marlinton, W. Va.	Above Beckley, W. Va.	Below Beckley, W. Va.	Above Richwood, W. Va.	Below Richwood, W. Va.	Below Falling Rock, W. Va.
River miles above:							
Confluence with New River	106.5	103	9.5	9	70	69	16
Mouth of Kanawha	267.5	264	143.5	143	167	166	74
Period	May and June 1940	May and June 1940	May 1940	May 1940	January and February 1940	January and February 1940	December 1939
Number of samples	3	3	3	3	2	2	2
Flow in cubic feet per second:							
Sampling days	3,800	3,800	18	18	330	330	
Minimum month	10	10			[1]	[1]	
Water temperature °C	15.5	16.0	17.0	16.3	0	0	6.0
Coliforms per milliliter	9	125	20	392	1	23	67
Dissolved oxygen, parts per million	9.0	9.1	8.6	8.5	13.4	13.0	10.8
Biochemical oxygen demand, 5-day, parts per million	.6	.7	[2] .8	[2] 2.0	1.8	1.2	1.8

[1] Less than 1.
[2] Acid sample—seeded and neutralized.

From one to four stream samples were collected and analyzed from each sampling point reached by a trailer unit and from four to nine samples monthly were obtained at the mouth during the 9-month period of sampling from the *Kiski*. Discharges were generally low during the periods from August 1939 to February 1940 and from December 1940 to February 1941. Medium high to high discharges prevailed from March to May 1940.

Figures K–3, K–4, and K–5 show graphically the coliform dissolved oxygen, and oxygen demand results. In the vicinity of Charleston and at the mouth, where the results were obtained over a period of months, the results shown on these spot maps represent the most unfavorable monthly averages. All other results represent the averages of the series of one to four samples collected at each point by a mobile unit over periods of less than 1 month.

From these results it appears that the larger streams of the Kanawha Basin are not seriously polluted except in the 40-mile stretch below Charleston. Bad localized conditions exist on the tributaries of the New River below Boone, West Jefferson, Wytheville, Pulaski, Christiansburg, Blacksburg, Bluefield, Pocahontas, and Beckley. The Greenbrier, Gauley, and Elk Rivers above Charleston are in relatively good sanitary condition. Gas, oil, and refinery wastes produce taste and odor problems along the Elk River.

Acid stream conditions were observed in the vicinity of Pulaski, Va., on Peak Creek and along Piney and Beaver Creeks near Beckley, W. Va., and along Dunloup Creek at Mount Hope. At Pulaski the acidity is due to wastes from a chemical plant while at the other points it is caused by mine drainage. The pHs of these streams ranged from 3.0 to 5.9 and phenolphthalein acidities from about 10 to more than 125 parts per million.

In collaboration with the West Virginia Department of Health and the State water commission, a survey of taste and odor problems along

the Kanawha and Elk Rivers, with particular reference to the problems existing in the Charleston area, was carried out in the winter of 1939–40 and again in 1940–41. Threshold odor examinations were made of the river waters at stations above, in, and below Charleston and of certain industrial wastes. These results show a marked increase in the threshold odor numbers of Kanawha River water in the vicinity of the Marmet Locks and Dam. Values of 300 to 400 were observed at various times at Marmet, Charleston, and South Charleston. On the Elk River the threshold odor numbers were generally below 50.

Odor determinations are at best rather crude criteria and are largely dependent upon the observer's ability at detection. Then, too, high intensity transient odors may mask more persistent but less intense troublesome odors. Odor determinations, both before and after storage under standard conditions, have been suggested as a means of eliminating transient odors. The results as a whole indicate that the odors tend to diminish progressively downstream from Charleston on the Kanawha and that odors along the Elk River tend to diminish from Clendenin to the Charleston intake. Threshold odor determinations made on the effluent from several industrial plants in the vicinity of Charleston and on the Elk River gave results ranging from about 500 to 1,000,000 or more. The odor determinations in themselves should serve more as a guide and should be supplemented with other chemical data before drawing too many conclusions from the results. Further treatment of industrial wastes probably will contribute to overcoming the taste and odor problem in this region.

Biological summary.—The flora and fauna of the Kanawha were found to be less than 1,000 parts per million, which may be due in part to the clean nature of the upper reaches and also the industrial wastes near Charleston and along the Elk River.

Hydrometric Data

More than 50 stream-gaging stations have been maintained in the Kanawha Basin at various times and 25 are currently in operation. Table K–6 shows monthly mean summer flows at 8 stations for the 3 driest summers of record at each station. Practically continuous discharge records are available on the Kanawha River at Kanawha Falls (mile 95) for the period since 1877, one of the longest periods of record in the Ohio Basin. Figure K–6 is a low-flow frequency curve for this stream based on the 4 summer months (June–September, inclusive). A second curve, plotted to the same scale, shows similar information for flows regulated by Bluestone Reservoir. It indicates that the frequencies with which various minimum monthly mean summer flows may be expected, both with and without Bluestone Dam regulation, are as follows:

Kanawha River at Kanawha Falls	Minimum monthly mean summer flows in cubic feet per second that may be expected once in—			
	2 years	5 years	10 years	Minimum
Unregulated	3,400	2,320	2,140	1,290
Regulated by Bluestone Reservoir	4,100	3,120	2,670	2,000

Fig. K-6

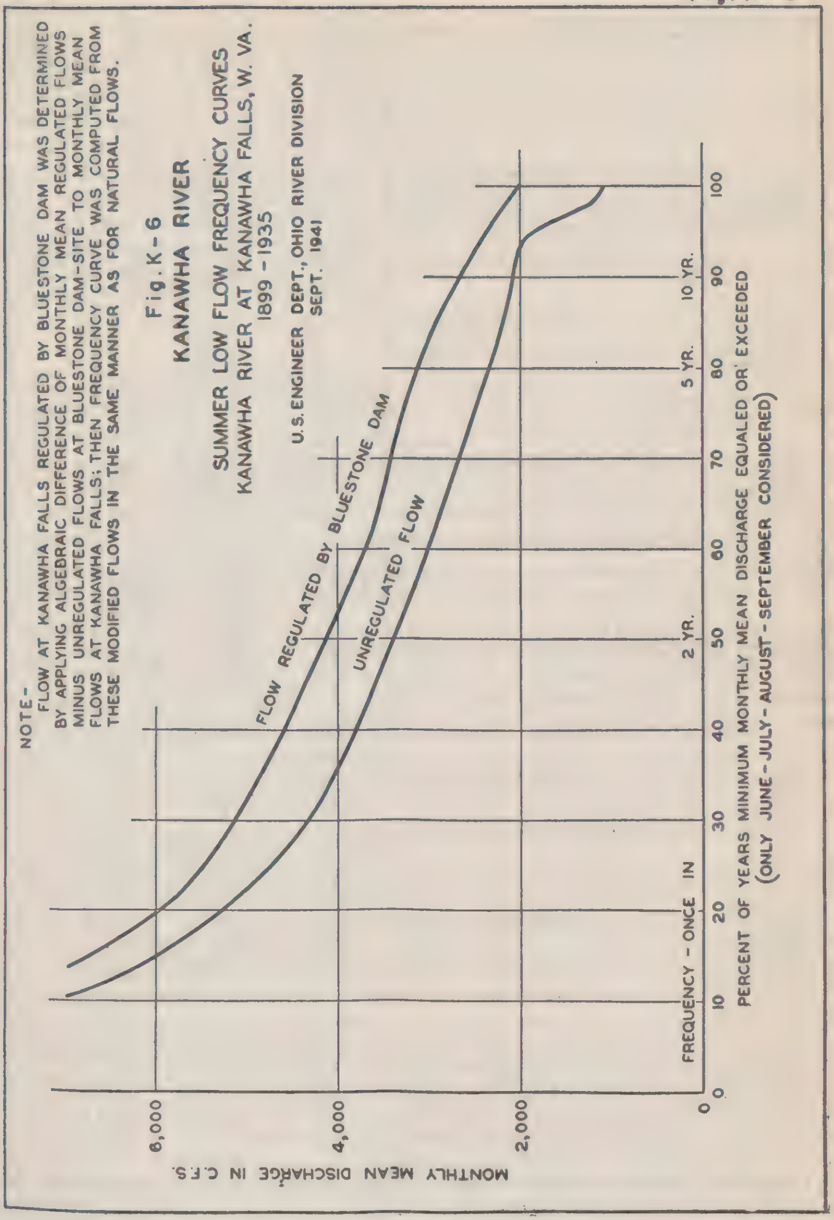

NOTE-
FLOW AT KANAWHA FALLS REGULATED BY BLUESTONE DAM WAS DETERMINED BY APPLYING ALGEBRAIC DIFFERENCE OF MONTHLY MEAN REGULATED FLOWS MINUS UNREGULATED FLOWS AT BLUESTONE DAM-SITE TO MONTHLY MEAN FLOWS AT KANAWHA FALLS; THEN FREQUENCY CURVE WAS COMPUTED FROM THESE MODIFIED FLOWS IN THE SAME MANNER AS FOR NATURAL FLOWS.
Fig. K-6
KANAWHA RIVER
SUMMER LOW FLOW FREQUENCY CURVES
KANAWHA RIVER AT KANAWHA FALLS, W. VA.
1899 - 1935
U.S. ENGINEER DEPT., OHIO RIVER DIVISION
SEPT. 1941
FLOW REGULATED BY BLUESTONE DAM
UNREGULATED FLOW
MONTHLY MEAN DISCHARGE IN C.F.S.
6,000
4,000
2,000
0
FREQUENCY - ONCE IN
2 YR.
5 YR.
10 YR.
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF YEARS MINIMUM MONTHLY MEAN DISCHARGE EQUALED OR EXCEEDED
(ONLY JUNE - JULY - AUGUST - SEPTEMBER CONSIDERED)

TABLE K–6.—*Kanawha River Basin—monthly mean summer flows for years in which low summer flows have occurred*

River	New	Kanawha,	Peak Creek	Bluestone,
Location	At Eggleston, Va.	Kanawha Falls, W. Va.	At Pulaski, Va.	Lilly, W. Va.
River miles above mouth of Kanawha	217	95	253	168
Drainage area (square miles)	2,941	8,367	68	438
Period of record	1915–37	1877–1940	1927–33	1908–16 1920–40
Year	1925	1930	1930	1930
June ... cubic feet per second	1, 530	2, 550	----------	36. 4
July ... do	1, 320	1, 290	----------	27. 2
August ... do	812	1, 520	----------	26. 2
September ... do	853	1, 310	0. 8	7. 3
Year	1930	1925	1932	1939
June ... cubic feet per second	1, 710	3, 370	14. 1	319
July ... do	999	2, 660	2. 7	182
August ... do	1, 250	1, 390	2. 3	90. 9
September ... do	1, 070	1, 340	1. 6	26. 3
Year	1932	1932	1929	1911
June ... cubic feet per second	2, 660	7, 160	221	88. 6
July ... do	1, 500	11, 300	19. 2	132
August ... do	1, 230	2, 910	8. 2	34. 5
September ... do	1, 020	1, 340	5. 6	40. 2

River	Greenbrier	Gauley	Elk	Coal
Location	Buckeye, W. Va.	Summersville, W. Va.	Queen Shoals, W. Va.	Ashford, W. Va.
River miles above mouth of Kanawha	263	142	84	72
Drainage area (square miles)	540	680	1,145	393
Period of record	1929–40	1908–16 1929–40	1929–40	1930–40
Year	1930	1930	1930	1930
June ... cubic feet per second	191	108	128	23. 4
July ... do	27. 8	13. 3	17. 1	6. 4
August ... do	21. 5	23. 5	13. 1	13. 4
September ... do	13. 5	7. 7	7. 2	1. 3
Year	1932	1939	1932	1939
June ... cubic feet per second	264	403	841	196
July ... do	896	1, 330	7, 280	121
August ... do	75. 1	464	570	32. 9
September ... do	35. 0	38. 7	52. 7	8. 3
Year	1934	1936	1939	1936
June ... cubic feet per second	149	90. 4	543	19. 6
July ... do	40. 6	57. 4	1, 650	29. 6
August ... do	56. 5	78. 0	586	36. 8
September ... do	234	56. 1	39. 4	45. 4

Proposed stream control.—The following proposed reservoirs in the Kanawha Basin have been studied by the United States Engineer Department in connection with the authorized program for Ohio River flood control:

Reservoir	Stream	Maximum storage, acre-feet	Supplemental flow made available, cubic feet per second
Poca	Pocatalico River	202,000	8
Clendenin	Elk River	108,000	70
Birch	Birch River	43,600	29
Summersville	Gauley River	315,000	134
Big Bend	Greenbrier River	108,500	74
Moores Ferry	New River	1,010,000	Unknown

The supplemental flows shown are those that could be made available by use of a portion of the flood-control storage capacity after the end of the flood season. Low-flow regulation by the Moores Ferry Reservoir would depend largely on possible power operations. Consideration is being given to such operation of the reservoirs.

Discussion

The major pollution problems of the Kanawha Basin are in the main Kanawha Valley in the vicinity of Charleston. Problems of lesser importance exist on the Elk River below oil and gas plants and on other streams below moderate sized and small municipalities.

Charleston and vicinity.—In the vicinity of Charleston the chemical industry discharges large volumes of wastes which constitute a drain on the oxygen resources of the river and cause objectionable tastes and odors in downstream water supplies. In addition to the industrial wastes, sewage from Charleston and other cities along the river is discharged untreated.

Laboratory results during the low-flow period in December 1939 showed a dissolved oxygen content of 3 parts per million in the Kanawha at the Winfield locks (mile 31.1). This represents a deficiency below saturation of about 8.7 parts per million. Such a deficiency during the summer would result in the complete exhaustion of all the oxygen in the stream with attendant nuisance conditions and destruction of aquatic life.

Because of the unique character of many of the chemical plants, their rapid growth, and the constant changes in processes and products, methods of accomplishing reduction in the strength or quantity of the wastes must be based on a rather complete study of each plant. Because of the technical and often secret nature of the industrial processes involved, pollution corrective measures are squarely up to the industries themselves. Outside assistance must be confined to determining which effluents are damaging and measuring accomplishments after corrective measures have been taken. The Ohio River pollution survey working with the State of West Virginia, has already located the damaging effluents. Several of the plants have undertaken studies and have instituted new practices, designed particularly to reduce the discharge of wastes causing tastes and odors in the water supplies taken from the Kanawha River. Intensified efforts on the part of the industrial research technicians as well as the State enforcement agency are necessary to prevent a steady deterioration in the quality of the lower Kanawha River because of the phenomenal growth of the chemical industry.

The capital cost of remedial or pollution control measures at the large industrial plants is estimated very approximately to be $1,000,000 and the annual operating cost to be $160,000. This estimate is much smaller than the cost of correcting an equivalent amount of organic pollution in the form of domestic sewage, and is more in line with the experience of a limited number of large industries confronted with organic and taste and odor pollution problems. The estimate may be subject to reduction with the development of efficient recovery practices.

Preliminary survey information on pollution loadings in the South Charleston area and river and industrial effluent quality were released to the State and served as a basis for pollution abatement discussion with the industries. As a result, a start toward pollution control has been, and is being, made by the industries. The program is in its early stages and, although a resurvey was made, no improvement of consequence was noted. This is not an adverse result as industrial activity had increased during the period between surveys and greater pollution might have been expected.

Although industrial pollution overshadows sewage pollution in importance on the Kanawha, the municipal wastes from Charleston and vicinity cause heavy bacterial loadings on downstream water supplies. Primary treatment and chlorination at these places seems justified to prevent sludge deposits and to reduce bacterial loadings.

Augmentation of low flows in the Kanawha by operation of the proposed flood-control reservoirs would be a distinct help in correcting conditions in the lower Kanawha. Such help would reduce, but would not eliminate, the need for sewage treatment and industrial waste remedial measures. There are probably limits to the effectiveness of industrial waste remedial measures which will necessitate the discharge of large amounts of polluting material even after a maximum of practicable treatment and recovery. Even with a reduction comparable to that effected by a secondary sewage treatment plant, the industrial wastes in the Charleston area would have a population equivalent of more than 200,000. Since continued growth is to be expected, conditions will become worse. The national-defense program is causing great increases in production at the chemical plants, both of war materials and of chemicals for synthetic fibers. The increased production will tend to aggravate stream conditions.

The Bluestone Reservoir, now being constructed by the United States Engineer Department, will increase the flow of the Kanawha by more than 600 cubic feet per second, or about 50 percent of the lowest summer monthly flow of record. Other reservoirs would supply less additional flow and their value for pollution control would be in proportion to the supplemental flow which they could provide. The Poca Reservoir, being downstream from Charleston, would have little value for pollution control. Augmentation of low flows by the Clendenin and Birch Reservoirs would insure the adequacy of Charleston's Elk River water supply and obviate the necessity of using the more heavily polluted Kanawha River water during extremely dry years.

Increased low flow is practically always a benefit to organic pollution abatement. However, in the case of bacterial and taste and odor pollution, benefits are offset, in part, by the decreased time of flow which reduces the time natural purification agencies have to act.

Miscellaneous pollution.—At other communities along the Kanawha and New Rivers, primary treatment will be sufficient to maintain excellent stream conditions. Secondary treatment is indicated at such places as Richwood and Princeton, W. Va., and Pulaski and Galax, Va., where stream flows often become very low. At Richwood pollution from a pulp mill has, until recently, caused serious pollution for some distance downstream in the Cherry River. The industry has now moved and with the treatment of Richwood's wastes the stream can be again made suitable for fish life.

Tastes and odors caused by wastes from the gas and petroleum industry in the Elk Basin give trouble at the Charleston water intake. Studies are being made to determine the best method of solving this problem.

Except for the Kanawha River in the Charleston area, and a few of the smaller tributaries, the streams of the Kanawha Basin can be maintained in good condition by the use of available waste treatment methods. The widespread use of the streams as sources of public water supplies and for recreational purposes justifies relatively high standards of water quality.

The estimated cost of the suggested pollution abatement program is summarized in table K–1 together with estimates of the cost of existing sewage treatment plants and of programs for primary and for secondary treatment of all wastes.

TABLE K-7.—*Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
East Fork, below Boone, N. C	KNrEf 412	Apr. 19, 1940	145	12.5	7.9	74.1	9.0	2,400	7.0	600	28	39
Do	do	Apr. 23, 1940	69	6.5	10.4	81.5	3.6	9,300		11		35
Do	do	Apr. 25, 1940	41	6.0	10.6	84.7	2.7	4,300		8	13	39
Boone Creek, below Boone, N. C	KNrBo 412	Apr. 19, 1940	87	12.5	8.3	77.5	6.5	240	7.1	650	32	51
Do	do	Apr. 23, 1940	41	8.0	9.8	82.2	8.7	93				
Do	do	Apr. 25, 1940	25	8.5	10.0	85.0	2.8	93			20	
Winkler Creek, below Boone, N. C	KNrW 411	Apr. 19, 1940	58	11.0	9.7	87.7	.8	46	6.9			
Do	do	Apr. 23, 1940	28	6.0	11.0	87.7	.8	4				
Do	do	Apr. 25, 1940	16	6.0	11.1	89.1	.6	2			10	
Little Buffalo Creek, above West Jefferson, W. Va.	KNrNfL 375	Apr. 19, 1940	2	12.5	7.0	65.0	6.4	2,400	7.1		40	
Do	do	Apr. 23, 1940	3	7.5	9.7	80.9	3.0	910				
Do	do	Apr. 25, 1940	4	7.5	9.8	81.4	1.9	1,500			30	
Little Buffalo Creek, below West Jefferson, W. Va.	KNrNfL 374	Apr. 19, 1940	2	12.5	6.7	62.7	9.8	1,100	7.1	525	41	63
Do	do	Apr. 23, 1940	3	7.5	9.6	79.5	3.9	430		8		53
Do	do	Apr. 25, 1940	4	7.5	9.8	81.6	2.0	2,400		10	31	50
Bledsoe Creek, above Sparta, N. C	KNrLrB 336	Apr. 19, 1940	6	12.0	9.4	86.3	.5	24	6.9		13	
Do	do	Apr. 23, 1940	8	6.0	10.8	86.2	.5	2				
Do	do	Apr. 25, 1940	10	6.0	10.8	86.7	.5	9			12	
Bledsoe Creek, 200 feet above mouth	KNrLrB 335	Apr. 19, 1940	6	12.5	9.4	88.0	1.3	460	7.1		18	
Do	do	Apr. 23, 1940	8	6.5	10.9	88.3	.7	460		5		29
Do	do	Apr. 25, 1940	10	6.0	10.9	87.3	.8	1,100		7	14	38
New River, above Fries, Va	KNr 199	Apr. 22, 1940	3,130	8.0	10.3	86.4	.9	21	6.9		15	
Do	do	Apr. 24, 1940	2,720	8.5	10.2	86.9	.6	15			15	
Do	do	Apr. 26, 1940	2,300	9.5	9.9	86.6	.8	15				
New River, below Fries, Va	KNr 197.5	Apr. 22, 1940	3,130	8.0	10.4	87.6	1.9	240	6.9		13	
Do	do	Apr. 24, 1940	2,720	8.5	10.0	85.2	1.0	460			14	
Do	do	Apr. 26, 1940	2,300	9.5	9.8	85.3	1.9	93				
Chestnut Creek, waterworks intake, Galax, Va.	KNrC 306	Apr. 22, 1940	159	9.0	10.7	92.5	.7	4	6.9		16	
Do	do	Apr. 24, 1940	107	7.5	10.5	87.1	.7	24			18	
Do	do	Apr. 26, 1940	105	9.5	9.9	86.6	.9	21				
Chestnut Creek, below milk plant, Galax, Va.	KNrC 305	Apr. 22, 1940	159	8.5	10.9	93.0	2.8	43	6.9		16	
Do	do	Apr. 24, 1940	107	7.5	10.5	87.1	1.0	240			16	
Do	do	Apr. 26, 1940	105	9.5	9.9	86.7	.9	23				

Chestnut Creek, below all sewage, Galax, Va.	KNrC 304	Apr. 22, 1940	159	9.0	10.8	92.8	5.1	460	6.9	14	16	5
Do	do	Apr. 24, 1940	107	7.5	10.4	86.6	1.2	150		29	18	37
Do	do	Apr. 26, 1940	105	9.5	9.8	85.4	1.4	210		15		54
New River, above Austinville, Va.	KNr 286	Apr. 22, 1940	5,360	8.5	10.2	87.2	1.3	24	6.9		16	
Do	do	Apr. 24, 1940	3,410	9.5	10.2	89.2	.8	46			16	
Do	do	Apr. 26, 1940	3,460	11.0	10.1	91.0	.8	24				
New River, bridge on Route 52, Austinville, Va.	KNr 282	Apr. 22, 1940	5,360	8.0	10.3	86.9	.8	43	7.0	150	19	43
Do	do	Apr. 24, 1940	3,410	9.0	10.3	89.2	.6	4		70	24	38
Do	do	Apr. 26, 1940	3,460	10.5	10.3	91.8	.7	43		48		53
Crooked Creek at mouth, Woodlawn, Va.	KNrCr 300.5	Apr. 24, 1940	87	7.5	10.8	89.9	.7	9	6.9	35	15	29
Do	do	Apr. 26, 1940	86	9.0				12				
Reed Creek above Wytheville, Va.	KNrRe 298	Apr. 11, 1940	126	10.0	10.1	88.8	2.2	4	7.8		71	
Do	do	Apr. 15, 1940	93	8.0	11.3	94.9	.8	1			88	
Do	do	Apr. 16, 1940	88	12.0	10.3	94.9	.8	24				
Reed Creek, below last sewer, Wytheville, Va.	KNrRe 297	Apr. 11, 1940	126	11.5	3.2	28.9	83.2	24,000	7.6		271	
Do	do	Apr. 15, 1940	93	12.0	3.0	27.4	297	46,000			238	
Do	do	Apr. 16, 1940	88	14.5	0	0	176	46,000				
Reed Creek, 2 miles below Wytheville, Va.	KNRRe 296	Apr. 11, 1940	126	10.5	10.3	92.2	1.2	1,100	8.2		77	
Do	do	Apr. 15, 1940	93	10.5	11.5	102.2	1.2	4		12	98	148
Do	do	Apr. 16, 1940	88	13.5	10.1	96.4	1.1	4		7		140
Peak Creek, above Pulaski, Va.	KNrP 268	Apr. 11, 1940	84	10.5	10.7	95.7	.8	46	7.8			
Do	do	Apr. 15, 1940	61	6.0	11.4	91.2	.3	1		4	40	101
Do	do	Apr. 16, 1940	58	10.5	10.2	90.9	.7	2		4		103
Peak Creek, below last sewer, Pulaski, Va.	KNrP 266.5	Apr. 11, 1940	84	10.5	8.2	72.7	[1] 15.7 6.8	24	3.3			
Do	do	Apr. 15, 1940	61	8.0	8.9	75.2	[1] 3.8 1.6	8	2.9			
Do	do	Apr. 16, 1940	58	12.5	7.2	66.9	[1] 3.8 1.9	46	3.0			
Peak Creek, below Chemical Co., Pulaski, Va.	KNrP 267	Apr. 11, 1940	84	13.0	9.2	86.7	[1] 2.5 .8					
Do	do	Apr. 15, 1940	61	8.5	9.1	77.2	[1] 1.1 .6	(2)	2.8			
Do	do	Apr. 16, 1940	58	12.5	7.4	69.2	[1] 2.0 .6	(2)	3.0			
New River, above Radford, Va.	KNr 248	Apr. 11, 1940	2,410	10.5	11.0	98.4	1.4	3	7.4	17	36	65
Do	do	Apr. 15, 1940	3,030	7.0	10.2	84.2	.8	1		10	42	88
Do	do	Apr. 16, 1940	3,300	13.0	10.5	99.3	1.4	1		9		53
New River, below Radford, Va.	KNr 247	Apr. 11, 1940	2,720	12.5	11.2	104.9	1.1	9	8.1		44	
Do	do	Apr. 15, 1940	3,270	7.0	10.4	85.2	.5	4			41	
Do	do	Apr. 16, 1940	3,520	10.0	10.1	88.2	.6	15				
Crab Creek, above Christiansburg, Va.	KNrCr 253.5	Apr. 10, 1940	4	17.0	13.6	139.6	6.1	240	8.7		229	
Crab Creek, at creamery, Christiansburg, Va.	KNrCr 252.5	Apr. 12, 1940	3	11.5	3.6	33.3	5.3	230			238	
Do	do	Apr. 17, 1940	2	13.5	.3	3.2	10.7	11,000				

[1] Seeded and neutralized.

TABLE K-7.—*Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Crab Creek, below treatment plant Christiansburg, Va.	KNrCr 252	Apr. 10, 1940	4	16.0	9.0	90.5	4.2	4,600	8.1		238	
Do	do	Apr. 12, 1940	3	10.5	9.2	82.2	4.8	750		56	229	270
Do	do	Apr. 17, 1940	2	11.5	9.3	84.7	3.6	210		20		270
Stroubles Creek, above sewage plant, Blacksburg, Va.	KNrSt 244	Apr. 10, 1940	5	11.5	9.5	87.0	3.2	9	8.0		198	
Do	do	Apr. 12, 1940	3	12.5	9.6	89.6	3.6	9			205	
Do	do	Apr. 17, 1940	2	14.5	11.1	107.8	3.4	4				
Stroubles Creek, below sewage plant, Blacksburg, Va.	KNrST 242	Apr. 10, 1940	5	12.0	9.0	82.9	3.1	930	7.9		201	
Do	do	Apr. 12, 1940	3	13.0	4.9	46.4	22.0	11,000			261	
Do	do	Apr. 17, 1940	2	14.5	8.2	79.9	9.7	2,300				
Stroubles Creek, 150 yards above mouth, Blacksburg, Va.	KNrSt 235.5	Apr. 10, 1940	26	9.5	11.6	101.3	1.6	1,100	7.8		71	
Do	do	Apr. 12, 1940	17	11.5	10.4	95.1	1.6	23		9	98	136
Do	do	Apr. 17, 1940	13	13.5	11.4	108.5	2.0	4		4		193
New River, 4.2 miles above Pearisburg, Va.	KNr 206	Apr. 10, 1940	2,320	9.0	10.9	94.0	.9	46	7.4		49	
New River, 2 miles above Pearisburg, Va.	KNr 204	Apr. 12, 1940	3,570	9.5	9.8	85.6	1.2	4			47	
Do	do	Apr. 17, 1940	2,950	14.0	9.8	94.4	.8	9				
New River, below Narrows, Va	KNr 199	Apr. 10, 1940	3,170	8.0	10.8	90.8	1.1	15	7.4	40	47	71
Do	do	Apr. 12, 1940	3,800	10.0	9.7	85.3	1.2	9		18	51	97
Do	do	Apr. 17, 1940	3,900	15.5	9.4	93.1	.9	4		17		99
Rich Creek, below Peterstown, Va	KNrRi 195	Apr. 29, 1940	30	11.5	10.4	94.9	.9	9	7.9	13	105	109
Do	do	May 2, 1940	24	10.0	10.3	90.6	1.5	150		65	74	74
Do	do	May 7, 1940	16	15.5	9.8	97.4	.7	23		11		106
Grassy Branch, below railroad yards drain, Bluefield, W. Va.	KNrErG 209	Apr. 29, 1940	1	22.5	6.9	78.7	20.5	360	7.9	230	112	162
Do	do	May 2, 1940	1	13.5	8.3	78.8	7.9	9		125	154	113
Do	do	May 7, 1940	1	21.5	6.0	67.5	45.5	230		97		136
East River, at mouth, Glenlyn, Va	KNrEr 189	Apr. 29, 1940	81	11.0		95.6	.7	23	7.9	7	113	118
Do	do	May 2, 1940	62	9.0	10.1	87.4	.9	240		21	116	109
Do	do	May 7, 1940	41	15.5	9.0	89.7	.5	9		6		115
New River, bridge below Glenlyn, Va.	KNr 189	Apr. 29, 1940	3,450	12.0	10.0	92.6	.5	15	7.5	14	53	69
Do	do	May 2, 1940	5,220	11.0	9.7	87.4	.7	9		24	52	52
Do	do	May 7, 1940	4,180	15.5	9.1	90.1	.6	7		13		63

Bluestone River, water plant intake, Bluefield, W. Va.	KNrBl 218	May 1, 1940	36	13.0	9.9	93.4	.5	15	7.8		102	
Do	do	May 6, 1940	26	14.0	10.7	103.4	.9	93			109	
Do	do	May 9, 1940	27	14.5	8.3	81.3	.7	9				
Bluestone River, above Beaver Pond Creek, Bluefield.	KNrBl 216.5	May 1, 1940	26	12.5	10.1	94.1	.9	43	7.9		107	
Do	do	May 6, 1940	20	12.0	10.7	99 1	1.4	240			108	
Do	do	May 9, 1940	20	15.5	8.4	83.4	1.2	43				
Beaver Pond Creek at mouth Bluefield, W. Va.	KNrBlB 216.5	May 1, 1940	9	12.0	8.3	76.7	4.0	2,400	7.8	15	134	133
Do	do	May 6, 1940	6	11.5	8.6	78.7	8.0	930		10	151	143
Do	do	May 9, 1940	6	12.5	8.0	74.3	2.8	930		10		137
Bluestone River, 1 mile below sewage plant, Bluefield.	KNrBl 215	May 1, 1940	36	12.5	9.0	84.4	2.6	23	7.6	14	113	109
Do	do	May 6, 1940	26	13.0	10.2	96.2	2.7	4		9	122	119
Do	do	May 9, 1940	27	15.0	7.7	76.0	3.6	7		9		120
Bluestone River, below Nemours, W. Va.	KNrBl 211	Apr. 30, 1940	74	17.0	8.6	88.4	2.1	23	7.6		83	
Do	do	May 3, 1940	59	7.0	9.3	76.3	2.4	23			88	
Do	do	May 8, 1940	37	22.5	7.9	90.3	2.3	23				
Laurel Creek, above Pocahontas, W. Va.	KNrBlL 211	Apr. 30, 1940	8	14.0	9.9	95.1	1.0	110	7.3		23	
Do	do	May 3, 1940	6	7.5	11.0	91.1	1.2	460			28	
Do	do	May 8, 1940	4	20.0	9.2	100.0	2.0	23				
Laurel Creek, below Pocahontas, W. Va.	KNrBlL 209.5	Apr. 30, 1940	8	16.0	7.5	75.5	6.3	4,600	6.8	70	26	120
Do	do	May 3, 1940	6	8.5	8.4	72.0	10.6	2,400		48	28	127
Do	do	May 8, 1940	4	21.0	5.7	63.8	10.0	11,000		22		141
Bluestone River, above Bramwell, W. Va.	KNrBl 208	Apr. 30, 1940	82	17.0	8.6	87.9	1.5	43	7.7		77	
Do	do	May 3, 1940	66	11.0	9.3	83.6	1.1	43			80	
Do	do	May 8, 1940	41	22.0	8.4	94.9	1.7	43				
Bluestone River, below Simmons, W. Va.	KNrBl 207	Apr. 30, 1940	87	15.0	8.4	82.4	.9	240	7.4		69	
Do	do	May 3, 1940	70	8.5	9.3	79.0	.9	460			72	
Do	do	May 8, 1940	46	19.5	7.6	81.6	1.3	91				
Crane Creek, at mouth Montcalm, W. Va.	KNrBlC 203	Apr. 30, 1940	20	13.5	9.6	91.4	.6	93	7.9	32	131	161
Do	do	May 3, 1940	16	7.5	10.0	83.0	1.0	75		36	145	168
Do	do	May 8, 1940	11	17.0	8.8	90.6	.6	93		28		171
Wide Mouth Creek, above Matoka, W. Va.	KNrBlW 205.5	May 1, 1940	21	10.5	9.4	83.7	1.3	110	7.6		89	
Do	do	May 6, 1940	14	8.0	10.0	84.2	.6	39			99	
Do	do	May 9, 1940	13	13.5	9.0	85.5	.8	460				
Wide Mouth Creek, below Matoka, W. Va.	KNrBlW 204	May 1, 1940	21	11.0	9.2	82.6	1.3	210	7.5		89	
Do	do	May 6, 1940	14	8.5	9.8	83.9	1.2	230			102	
Do	do	May 9, 1940	13	14.0	8.3	80.2	8.0	2,400				
Wide Mouth Creek, at mouth	KNrBlW 201.5	May 1, 1940	32	11.5	9.7	88.2	1.0	43	7.6	12	78	146
Do	do	May 6, 1940	20	10.0	10.2	89.9	2.0	23		7	90	165
Do	do	May 9, 1940	20	16.5	9.0	91.6	.9	93		12		175

TABLE K-7.—*Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Bluestone River, Kegley, W. Va.	KNrBl 193	Apr. 30, 1940	208	14.0	9.2	88.5	.6	21	7.6		71	
Do	do	May 3, 1940	167	8.0	9.9	83.2	1.0	240		14	80	120
Do	do	May 8, 1940	102	18.5	8.3	88.3	.7	23				
Brush Creek, above Princeton, W. Va.	KNrBlBr 191.5	Apr. 29, 1940	26	15.0	10.0	98.2	.5	150	7.0		27	
Do	do	May 2, 1940	22	10.0	9.2	81.4	.7	21			37	
Do	do	May 7, 1940	13	17.5	9.1	94.3	.5	93				
Brush Creek, below Princeton, W. Va.	KNrBlBr 189	Apr. 29, 1940	26	14.0	8.2	78.6	2.3	360	7.0		32	
Do	do	May 2, 1940	22	9.5	6.6	57.6	1.0	150		19	46	48
Do	do	May 7, 1940	13	17.5	1.8	18.4	4.0	2,400				
Laurel Creek, below Athens, W. Va.	KNrBlLa 185	Apr. 29, 1940	8	11.0	10.7	96.6	2.4	1,100	7.3	11	38	54
Do	do	May 2, 1940	6	9.5	10.4	91.2	3.8	430		12	49	56
Do	do	May 7, 1940	3	15.0	8.0	78.3	6.5	11,000		22		62
Brush Creek, at mouth, Speedway, W. Va.	KNrBlBr 182	Apr. 29, 1940	42	13.0	10.3	97.5	.6	9	7.3	17	30	51
Do	do	May 7, 1940	22	15.5	9.6	96.0	1.4	3		8	48	47
Bluestone River, at mouth	KNrBlBr 182	Apr. 30, 1940	370	14.0	9.5	92.0	.5	23	7.5	14	45	66
Do	do	May 3, 1940	303	9.0	10.1	86.8	.8	15		52		
Do	do	May 8, 1940	178	19.0	8.6	91.8	.9	4		8		87
East Fork Greenbrier River, above Durbin, W. Va.	KNrGrEf 300	May 27, 1940	772	13.0	10.0	94.3	.8	4	6.9		18	
Do	do	May 31, 1940	990	12.5	10.0	93.2	.8	24	6.8		17	
Do	do	June 5, 1940	319	17.0	9.8	100.5	.4	12	6.9			
East Fork Greenbrier River, below Durbin, W. Va.	KNrGrEf 297	May 27, 1940	772	12.5	9.5	88.8	2.7 [1] 2.2	4	8.7		22	
Do	do	May 31, 1940	990	13.5	9.9	94.7	1.3	9	7.0	27	20	18
Do	do	June 5, 1940	319	16.5	9.4	95.3	1.6	4	7.2	4		23
Greenbrier River, below Durbin, W. Va.	KNrGr 295	May 27, 1940	1,390	13.5	9.5	90.3	1.5	4	7.2	12	19	23
Do	do	May 31, 1940	2,800	13.5	9.8	93.5	1.1	24	6.9		19	
Do	do	June 5, 1940	415	17.5	9.2	95.9	1.1	9	7.0			
Greenbrier River below Cass, W. Va.	KNrGr 291	May 27, 1940	1,390	14.0	9.4	90.2	.6	9	7.1		22	
Do	do	May 31, 1940	2,800	12.5	9.7	90.8	.8	9	6.9		20	
Do	do	June 5, 1940	415	17.0	9.4	96.3	.5	9	7.0			
Greenbrier River, above Marlington, W. Va.	KNrGr 267.5	May 27, 1940	3,470	14.5	9.0	87.8	.7	4	7.2		29	
Do	do	May 31, 1940	6,010	13.0	9.7	91.2	.4	15	7.0		21	
Do	do	June 5, 1940	1,930	19.0	8.3	88.8	.5	9	7.1			

Greenbrier River, below Marlington, W. Va.	KNrGr 264	May 27, 1940	3,470	16.0	9.4	94.5	.9	43	7.1		24	
Do	do	May 31, 1940	6,010	13.0	9.6	90.7	.7	93	7.1		28	
Do	do	June 5, 1940	1,930	19.0	8.5	89.2	.6	240	7.3			
Howard Creek, below White Sulphur Springs, W. Va.	KNrGrH 213.5	May 29, 1940	81	13.5	9.5	91.0	.3	4	7.2		43	
Do	do	June 4, 1940	52	15.5	9.0	89.8	.4	2	7.2	42		
Do	do	June 6, 1940	58	18.0	8.5	88.8	.1	4				
Howard Creek, at mouth Caldwell, W. Va.	KNrGrH 208.5	May 29, 1940	121	12.5	9.5	88.9	.3	23	7.2	3	43	45
Do	do	June 4, 1940	77	16.0	9.1	91.8	.4	23	7.2	4	38	49
Do	do	June 6, 1940	88	18.0	8.5	89.4	1.0	43		4		
Greenbrier River, waterworks intake, Lewisburg, W. Va.	KNrGr 208.5	May 27, 1940	2,320	17.5	9.2	95.1	1.0	24	7.1	18	28	28
Do	do	May 31, 1940	10,400	13.5	9.5	90.6	.7	110	7.0	170	37	31
Do	do	June 5, 1940	994	23.5	9.0	104.3	.7	4	7.3	22		33
Greenbrier River, Ronceverte, W. Va.	KNrGr 203	May 28, 1940	2,580	17.0	9.2	94.4	.9	43	7.1		30	
Do	do	June 3, 1940	1,910	19.0	9.3	99.6	.6	4	7.3		33	
Do	do	June 6, 1940	1,200	23.0	9.0	103.3	.4	9	7.3			
Fort Spring Creek, Fort Spring, W. Va.	KNrGrF 194	May 28, 1940	163	12.5	9.0	84.3	.8	93	7.4	52	116	104
Do	do	June 3, 1940	121	14.5	9.3	90.6	1.7	43	7.5	27	118	109
Do	do	June 6, 1940	76	15.0	8.8	86.7	.7	23	7.4	18		123
Greenbrier River, waterworks intake, Alderson, W. Va.	KNrGr 188	May 28, 1940	2,580	16.0	8.9	89.6	.9	9	7.2		33	
Do	do	June 3, 1940	1,910	18.0	9.1	95.6	.6	9	7.3		37	
Do	do	June 6, 1940	1,200	21.0	8.0	89.2	.4	46				
Greenbrier River, below Alderson, W. Va.	KNrGr 187	May 28, 1940	2,580	15.0	9.9	97.9	.6	15	7.2		31	
Do	do	June 3, 1940	1,910	16.5	9.0	91.2	.4	9	7.3		49	
Do	do	June 6, 1940	1,200	21.0	8.1	90.3	.3	23				
Greenbrier River, Hinton, W. Va.	KNrGr 161.5	May 28, 1940	6,900	15.5	9.0	90.0	.6	23	7.2	25	37	36
Do	do	June 3, 1940	5,300	16.0	9.2	92.0	.4	240	7.3	16	42	38
Do	do	June 6, 1940	2,900	21.5	8.3	92.9	.4	75		15		46
New River, Hinton, W. Va.	KNr 159	May 28, 1940	12,600	16.0	8.9	89.8	.9	9	7.3	45	40	46
Do	do	June 3, 1940	15,200	18.5	8.8	93.2	.8	4	7.4	29	55	46
Do	do	June 6, 1940	12,200	22.0	8.1	91.7	.7	110		30		57
Glade Creek, above Beckley, W. Va.	KNrGl 152.5	May 15, 1940	6	12.5	9.1	84.8	.7	4	6.8	6	13	18
Do	do	May 20, 1940	4	16.5	8.4	85.4	.9	24	6.7	12	15	17
Do	do	May 23, 1940	4	16.0	8.6	86.5	.5		6.7	4		
Big Beaver Creek, at mouth Beckley, W. Va.	KNrPiB 143	May 15, 1940	13	16.5	9.0	90.9	1.8 [1]2.6	46	3.9	3		78
Do	do	May 20, 1940	10	16.0	8.8	87.9	2.1 [1]1.2	460	4.2	45	11	64
Do	do	May 23, 1940	9	16.0	8.6	86.6	.9 [1]1.5	23	3.7	10		59

[1] Seeded and neutralized.

TABLE K-7.—*Kanawha River Basin: Ohio River pollution survey laboratory data— Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Piney River, above treatment plant, Beckley, W. Va.	KNrPi 143.5	May 15, 1940	23	17.0	8.9	91.2	.8 [1] 1.0	4	5.3		11	
Do	do	May 20, 1940	16	17.0	8.2	84.6	1.1 [1] 1.0	46	4.5		10	
Do	do	May 23, 1940	16	17.0	8.8	89.8	.3 [1] .3	9	4.8			
Piney River, below treatment plant, Beckley, W. Va.	KNrPi 143	May 15, 1940	23	16.0	8.6	86.7	2.5 [1] 3.2	210	5.5		10	
Do	do	May 20, 1940	16	17.0	8.2	84.7	2.2 [1] 1.8	930	4.9		13	
Do	do	May 23, 1940	16	16.0	8.6	86.5	.9 [1] 1.0	36	4.8			
Little Whitestick Creek, above treatment plant, Beckley, W. Va.	KNrPiL 141	May 13, 1940	3	14.0	9.6	92.1	1.5	1,100	8.1		135	
Do	do	May 16, 1940	3	12.0	9.6	88.2	.9	43	7.5		69	
Do	do	May 21, 1940	3	13.0	9.3	87.5	.8	43	7.4		62	
Little Whitestick Creek below treatment plant, Beckley, W. Va.	KNrPiL 139	May 13, 1940	3	15.0	4.8	47.1	72.7	24,000	7.6	90	179	126
Do	do	May 16, 1940	3	12.5	7.5	70.4	6.8	4,300	7.5	9	76	160
Do	do	May 21, 1940	3	13.5	8.1	77.7	3.9	360	7.3	14	59	86
Mountain Stream, Mabscott, W. Va.	KNrPiM 147	May 15, 1940		16.0	7.7	77.6	1.1	23	6.7	14	36	209
Do	do	May 18, 1940		14.5	8.5	82.9	.4 [1] .8	4	5.1	12	17	189
Piney River, above Raleigh, W. Va.	KNrPi 142	May 13, 1940	27	17.5	8.6	89.4	.7	4	6.5	8	15	72
Do	do	May 16, 1940	22	14.5	8.7	84.4	.4	2	6.8	7	15	77
Do	do	May 21, 1940	19	15.5	8.7	86.8	.6	24	6.6	27	12	44
Whitestick Creek, at mouth	KNrPiW 143.5	May 15, 1940	6	18.5	8.8	93.2	1.6	460	7.3	4	32	262
Do	do	May 20, 1940	5	15.0	8.1	79.7	6.0	2,400	7.1	135	38	110
Do	do	May 23, 1940	4	15.5	8.3	82.6	4.6	430	7.3	12		109
Beaver Creek, above Blue Jay, W. Va.	KNrPiB 147	May 15, 1940	11	14.5	8.1	79.2	.5 [1] .5	(2)	3.9			
Do	do	May 20, 1940	9	14.5	8.1	78.6	.8 [1] .5	2	3.6			
Do	do	May 23, 1940	8	15.5	7.9	79.0	.2 [1] .2	(2)	4.2			
Piney River, at mouth, McCreery, W. Va.	KNrPi 134	May 15, 1940	59	17.5	9.0	93.8	.9	4	7.0	2	19	114
Do	do	May 20, 1940	47	16.5	8.1	81.8	3.9	110	6.8	175	22	83
Do	do	May 23, 1940	42	16.5	8.9	90.2	.4	9	6.7	3		73

Dunloup Creek, above Mount Hope, W. Va.	KNrD 132	May 15, 1940	7	12.0	9.7	89.2	.6	1	3.7			
Do	do	May 17, 1940	6	11.5	9.8	89.3	.6 1.5	1	3.5			
Do	do	May 22, 1940	5	13.0	9.2	86.5	.2 1.3	4	3.7			
Dunloup Creek, below Mount Hope, W. Va.	KNrD 130.5	May 14, 1940	7	16.0	8.2	82.7	6.7 [1] 6.4	1	3.7			
Do	do	May 17, 1940	6	12.5	8.3	77.4	2.6 [1] 1.3	3	3.6			
Do	do	May 22, 1940	5	15.0	8.6	85.0	1.5 1.9	46	3.9			
Dunloup Creek, below Scarbro, W. Va.	KNrD 127	May 14, 1940	14	17.5	8.7	90.1	1.4	1,100	8.3		252	
Do	do	May 17, 1940	1	13.5	9.5	90.5	1.3	1,500	8.2		260	
Do	do	May 22, 1940	1	15.0	8.8	87.1	.6	230	7.5			
Dunloup Creek, below Harvey, W. Va	KNrD 125.5	May 14, 1940	20	16.0	9.0	90.0	.9	93	7.5		110	
Do	do	May 17, 1940	16	14.0	9.5	91.7	1.4	460	7.5		91	
Do	do	May 22, 1940	14	16.5	9.1	92.8	.3	36	7.0			
Dunloup Creek at mouth, Thurmond, W. Va.	KNrD 122.5	May 14, 1940	26	16.0	9.2	92.6	.6	39	7.3	23	44	234
Do	do	May 17, 1940	22	14.0	9.8	94.3	.9	43	7.1	18	29	236
Do	do	May 22, 1940	18	15.5	9.3	92.7	.4	23	6.8	17		117
Arbuckle Creek, below Minden, W. Va.	KNrAr 123	May 14, 1040	7	16.0	8.9	89.7	4.0	1,100	8.1	15	213	123
Do	do	May 17, 1940	6	14.5	9.2	90 2	3.5	2,400	8.1	8	211	124
Do	do	May 22, 1940	5	17.5	8.1	83.6	1.9	430	1.9	13		84
Wolf Creek above Fayetteville, W. Va.	KNrWo 110	May 14, 1940	6	13.5	9.1	87.2	.8	4	7.5		57	
Do	do	May 17, 1940	4	15.0	9.9	97.7	.8	4	7.5		70	
Do	do	May 22, 1940	4	15.5	9.0	89.6	.3	9	6.7			
Branch Laurel Creek, below Fayetteville, W. Va.	KNrWo 109.5	May 14, 1940		12.5	9.4	87.9	.6	4	6.9	4	21	26
Do	do	May 17, 1940		13.0	9.8	92.7	.6	1	6.8	5	21	24
Do	do	May 22, 1940		14.5	9.0	87.8	.5	9	6.6	11		25
Wolfe Creek, below Fayetteville, W. Va.	KNrWo 109	May 14, 1940	6	12.5	10.1	94.2	.6	4	8.4	3	229	62
Do	do	May 17, 1940	4	13.0	10.3	97.1	.7	2	8.5	3	240	49
Do	do	May 22, 1940	4	16.0	9.4	94.8	.8	23	7.3	8		29
New River, at mouth	KNr 97	Dec. 5, 1939	1,580	5.5	12.0	94.5	.5	4	7.4	8	65	97
Do	do	Dec. 7, 1939	1,910	5.5	12.3	97.0	1.2	1	7.5	6	65	
Gauley River, above mouth of Cherry River.	KGa 157.5	Jan. 15, 1940	1,710	0	13.3	91.0	1.4	46	6.0	15	6	55
Do	do	Feb. 9, 1940	1,020	0	13.4	91.5	.6	4	6.1	7	6	47
Cherry River at water intake above Richwood.	KGaC 167	Jan. 15, 1940	435	0	13.4	91.3	3.1	1	5.9	15	5	
Do	do	Feb. 9, 1940	225	0	13.4	91.3	.5	1	6.1	6	5	43
Cherry River, below Richwood, W. Va.	KGaC 166	Jan. 15, 1940	435	0	13.1	89.8	1.8	43	5.9	8	6	
Do	do	Feb. 9, 1940	225	0	13.0	89.0	.6	4	6.3	17	8	51

[1] Seeded and neutralized.
[2] Less than 1.

TABLE K-7.—*Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Cherry River, below Fenwich, W. Va	KGaC 164	May 29, 1940	605	13.5	10.0	95.0	.4	4	6.8	6	14	19
Do	do	June 4, 1940	593	17.5	9.2	95.9	.3	2	6.8	35	21	26
Do	do	June 7, 1940	294	20.0	8.9	96.8	.3	9	----	12	----	19
Gauley River, ½ mile below mouth Cherry River.	KGa 157	Jan. 15, 1940	1,680	0	13.2	90.2	1.2	93	6.0	13	6	49
Do	do	Feb. 9, 1940	1,480	0	13.4	91.5	.4	9	6.2	5	6	49
Arbuckle Creek, below Summerville, W. Va.	KGaA 143.5	May 29, 1940	1	14.5	9.0	88.1	.6	240	6.7	10	21	47
Do	do	June 4, 1940	1	17.0	8.5	87.7	.1	93	6.7	20	25	22
Do	do	June 7, 1940	(2)	21.5	7.6	84.8	.7	460	----	14	----	22
Sewell Creek, above Rainelle, W. Va.	KGaMS 157	May 29, 1940	56	15.5	9.7	96.8	6	4	6.7	----	17	----
Do	do	June 4, 1940	43	17.0	9.1	93.6	.2	9	6.8	----	25	----
Do	do	June 7, 1940	28	21.5	8.5	95.5	.2	15	----	----	----	----
Sewell Creek, below East Rainelle, W. Va.	KGaMS 155.5	May 29, 1940	116	15.0	9.0	89.0	1.0	460	6.7	24	21	18
Do	do	June 4, 1940	89	18.0	8.3	87.2	.4	2,400	6.7	17	23	19
Do	do	June 7, 1940	57	22.0	7.4	84.4	.6	430	----	13	----	----
Gauley River, at mouth	KGa 97	Dec. 5, 1939	62	4.5	12.1	93.1	2.6	1,100	6.7	8	15	79
Do	do	Dec. 7, 1939	198	4.5	12.2	94.0	2.3	93	6.8	5	14	----
Kanawha River, water intake, Glen Ferris, W. Va.	K 95.6	Feb. 14, 1940	16,700	3.5	12.5	93.7	.4	15	6.2	15	10	----
Do	do	Feb. 20, 1940	18,300	4.0	12.6	96.1	2.5	9	6.7	11	14	----
Kanawha River, 2 miles below Gauley Bridge.	do	Dec. 5, 1939	1,640	4.0	12.1	91.8	.6	9	7.3	11	63	116
Do	do	Dec. 7, 1939	2,110	4.0	12.0	91.5	.8	4	7.5	6	65	----
Mountain Stream, Charleston Height, W. Va.	K 93	Feb. 14, 1940	----	4.0	11.8	90.3	1.5	(2)	6.9	3	23	----
Do	do	Feb. 20, 1940	----	6.0	11.5	92.0	.7	(2)	6.7	5	20	----
Kanawha River, water intake, Alloy, W. Va.	K 89.7	Feb. 14, 1940	16,700	3.5	12.6	94.9	.6	46	6.9	37	19	----
Do	do	Feb. 20, 1940	18,300	6.0	12.8	102.6	1.0	43	6.7	15	16	----
Kanawha River, lower edge Harewood, W. Va.	K 88	Mar. 12, 1940	5,930	3.0	13.1	97.3	.6	23	7.1	6	27	----
Kanawha River, waterwoks intake, Montgomery, W. Va.	K 85.6	Feb. 14, 1940	16,700	2.0	13.1	94.9	1.3	110	7.1	77	31	----
Do	do	Feb. 20, 1940	18,300	4.0	13.2	100.5	.8	23	6.9	18	30	----
Kanawha River, United States lock at London, W. Va.	K 82.8	Dec. 5, 1939	1,660	6.5	11.8	95.8	.8	150	7.3	9	63	113
Do	do	Dec. 7, 1939	2,140	6.0	11.7	93.8	1.0	23	7.5	7	66	----
Do	do	Dec. 14, 1939	2,220	5.5	12.1	95.5	2.9	14	7.3	20	60	----

Do	do	Jan. 4, 1940	1,340	0	13.7	93.6	.8	46	7.2	5	52	
Do	do	Jan. 10, 1940	1,840	2.0	14.1	102.0	.8	9	7.2	5	54	
Do	do	Jan. 18, 1940	4,850	2.0	14.0	101.1	1.1	21	7.2	8	39	
Kanawha River, water intake, Cedar Grove, W. Va.	K 77.5	Mar. 12, 1940	6,650	4.0	13.2	100.7	.6	23	7.1	12	29	
Cabin Creek, at mouth, Chelyan, W. Va.	K 74.4	Mar. 12, 1940	36	4.0	12.2	93.1	1.2	240	7.1	4	24	
Kanawha River, water intake, Chelyan, W. Va.	K 73.7	Feb. 14, 1940	16,900	1.0	13.2	92.8	2.0	15	7.1	120	33	
Do	do	Feb. 20, 1940	18,500	4.5	12.7	98.1	1.5	46	6.9	19	25	
Kanawha River, United States lock, Belle, W. Va.	K 67.7	Dec. 5, 1939	1,760	9.0	9.6	82.7	3.5	43	7.5	13	78	100
Do	do	Dec. 7, 1939	2,090	8.5	10.2	87.2	3.2	150	7.4	12	69	
Do	do	Dec. 14, 1939	2,180	7.5	10.7	89.1	5.6	23	8.2	11	80	
Do	do	Jan. 4, 1940	1,180	2.5	12.6	91.9	3.4	8	7.2	8	51	
Do	do	Jan. 10, 1940	1,650	2.0	12.1	87.1	3.3	4	7.3	14	57	
Do	do	Jan. 18, 1940	4,930	2.0	12.9	93.1	2.0	24	7.4	6	48	
Do	do	Jan. 31, 1940	2,290	2.0	13.0	93.9	1.5	24	7.3	18	50	
Kanawha River, Kanawha city bridge, Charleston, W. Va.	K	Feb. 24, 1941	5,740	0	12.6	86.4	4.0	15	7.6			
Do	do	Feb. 28, 1941	6,300	1.5			2.3	43	7.6			
Kanawha River, C. & O. bridge, Charleston, W. Va.	do	Feb. 24, 1941	5,740	.5	13.0	90.2	2.6	4	7.6			
Do	do	Feb. 28, 1941	6,300	2.0	12.2	88.1	4.1	23	7.4			
Kanawha River, Patrick St. bridge, Charleston, W. Va.	K 56.3	Dec. 8, 1939	2,250	7.0	8.6	70.3	3.2	1,100	7.4	17	73	
Do	do	Dec. 14, 1939	2,970	4.5	10.1	77.9	3.2	240	7.2	16	53	
Do	do	Jan. 4, 1940	1,370	.5	11.8	81.8	3.1	313	7.1	17	45	
Do	do	Jan. 10, 1940	1,800	1.5	11.6	82.8	5.4	1,100	7.0	22	52	
Do	do	Jan. 18, 1940	6,060	.5	13.1	90.6	1.2	70	7.3	16	48	
Do	do	Jan. 31, 1940	2,520	1.5	12.3	87.5	2.2	930	7.4	22	53	
Do	do	Feb. 2, 1940	2,230	2.0	11.6	83.9	5.1	73	7.1	28	53	
Do	do	Feb. 24, 1941	5,740	0	12.9	88.1	2.4	240	7.4			
Do	do	Feb. 28, 1941	6,300	0	13.2	90.3	.8	210	7.0			
Kanawha River, below capitol building, Charleston, W. Va.	K	Mar. 12, 1941	7,850	4.0	12.4	94.7	4.3	91	7.2	15	33	
Kanawha River, above Bratfore St., Charleston, W. Va.	do	do	7,850	4.0	11.9	90.0	16.9	11,000	7.2	22	37	
Kanawha River, foot of Capitol St., Charleston, W. Va.	do	do	7,850	6.0	10.6	84.8	43.7	24,000	7.4	70	53	
Kanawha River, below Truslow St., Charleston, W. Va.	do	do	7,850	4.0	11.7	88.8	44.7	24,000	7.3	45	44	
Elk River, waterworks intake, Webster Springs, W. Va.	KEl 198	Jan. 15, 1940	524	0	13.4	91.5	2.3	110	6.6	64	25	22
Elk River, ½ mile above waterworks, Webster Springs, W. Va.	KEl 198.5	Feb. 9, 1940	654	2.0	13.1	94.8	1.0	9	6.7	59	7	23
Elk River, railroad bridge, 100 yards below forks, Webster Springs, W. Va.	KEl 196.5	do	654	2.5	13.4	97.9	.6	23	6.4	42	10	14
Elk River, ½ mile below Webster Springs, W. Va.	KEl 197	Jan. 15, 1940	524	0	13.3	91.2	1.0	43	6.1	53	17	11

[3] Less than 1.

TABLE K-7.—*Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Elk River, waterworks intake, Sutton, W. Va.	KEl 159	Jan. 15, 1940	1,150	.5	13.5	93.5	.4	2	6.3	57	5	11
Do	do	Feb. 9, 1940	1,300	2.0	13.4	96.8	.4	4	6.3	45	15	12
Elk River, ½ mile below Sutton, W. Va.	KEl 157.5	Jan. 15, 1940	1,150	.5	13.6	94.3	1.6	43	6.3	56	9	12
Do	do	Feb. 9, 1940	1,300	2.5	13.3	97.7	.5	43	6.4	52	12	12
Elk River, ¾ mile below Gassaway, W. Va.	KEl 152	Jan. 15, 1940	1,150	3.0	13.4	99.6	.4	75	6.3	68	8	13
Do	do	Feb. 9, 1940	1,300	5.0	13.1	102.0	.4	43	6.4	49	25	12
Elk River, above Clendenin, W. Va.	KEl	Dec. 4, 1939	86	6.0	11.4	91.6	2.5	24	6.9	54	13	24
Do	do	Dec. 6, 1939	138	5.5	11.6	91.6	.7	9	6.9	8	21	....
Elk River, below Clendenin, W. Va.	KEl	Dec. 4, 1939	86	5.0	10.6	83.0	3.3	1,100	6.9	20	27	72
Do	do	Dec. 6, 1939	138	6.0	10.9	87.6	1.7	21	6.9	11	26	....
Elk River, 1 mile below refining company, Falling Rock, W. Va.	KEl	Dec. 4, 1939	100	6.0	10.7	85.5	2.1	110	6.9	8	25	70
Do	do	Dec. 6, 1939	161	6.0	10.8	86.9	1.4	23	6.9	9	26	....
Elk River, bridge at Big Chimney, W. Va.	KEl 79.5	Dec. 14, 1939	1,080	3.5	11.8	88.7	1.6	43	6.9	10	26	....
Do	do	Jan. 14, 1940	250	0	13.9	95.3	.8	9	6.8	7	16	....
Do	do	Jan. 10, 1940	200	0	13.4	91.9	.7	8	6.7	7	16	....
Do	do	Jan. 18, 1940	1,530	0	13.5	92.6	.5	9	6.7	15	14	....
Do	do	Feb. 24, 1941	....	4.0	13.4	102.4	1.4	24	7.0	....	....	....
Do	do	Feb. 28, 1941	....	0	13.4	91.9	1.2	4	6.9	....	....	....
Elk River, water intake 4 miles above Charleston. W. Va.	KEl 75	Dec. 4, 1939	116	5.0	10.9	85.3	1.7	24	7.0	81	7	33
Do	do	Dec. 6, 1939	186	5.5	10.5	82.9	2.4	9	6.9	10	34	....
Elk River, filter plant, Charleston, W. Va.	KEl 71	Dec. 4 1939	116	5.0	10.1	79.0	1.7	1,100	7.0	8	30	79
Do	do	Dec. 5, 1939	153	6.0	10.2	81.5	1.8	460	6.9	7	32	62
Elk River, Coon Skin intake, Charleston, W. Va.	do	Mar. 12, 1939	1,590	3.5	12.7	95.4	1.3	4	6.3	3	12	....
Elk River, Virginia St. Bridge, Charleston, W. Va.	KEl 60	Jan. 4, 1939	250	1.0	13.8	97.0	1.3	110	6.7	9	16	....
Do	do	Jan. 10, 1939	200	0	13.5	92.5	1.0	93	6.7	12	17	....
Do	do	Jan. 18, 1939	1,530	0	13.7	93.4	.5	23	6.8	17	16	....
Do	do	Feb. 24, 1941	....	.5	13.9	96.7	1.5	43	6.9	....	....	....
Do	do	Feb. 28, 1941	....	0	13.4	91.4	1.6	460	6.8	....	....	....
Elk River, Washington St. Bridge, Charleston. W. Va.	KEl 58	Mar. 12, 1941	1,590	3.0	12.6	93.8	.5	43	6.9	8	13	....

Two Mile Creek, at mouth Charleston, W. Va.	KTw 55	Mar. 4, 1941	340	6.5	11.2	90.5	2.2	430	6.9	110	21	
Do	do	Mar. 12, 1941	8	2.0	11.4	82.4	6.6	15	7.1	11	46	
Kanawha River, toll bridge, St. Albans, W. Va.	K 45.6	Dec. 6, 1939	1,820	9.0	4.6	39.8	4.8	430	7.3	11	73	204
Do	do	Dec. 8, 1939	2,250	8.0	3.8	32.4	2.9	210	7.4	12	72	
Do	do	Dec. 14, 1939	2,970	6.0	5.3	42.1	3.9	132	7.2	18	69	
Do	do	Jan. 4, 1940	1,370	3.0	10.6	79.0	5.8	93	7.0	21	39	
Do	do	Jan. 10, 1940	1,800	1.0	10.5	73.9	7.6	60	8.7	27	61	
Do	do	Jan. 18, 1940	6,060	1.0	12.2	85.5	3.7	240	7.4	12	52	
Do	do	Jan. 29, 1940	1,800	0	11.3	77.6	7.5	93	7.3	17	45	
Kanawha River, toll bridge, St Albans, W. Va.	K 45.6	Jan. 31, 1940	2,520	2.0	11.7	84.5	4.9	240	7.3	21	47	
Do	do	Feb. 13, 1940	2,770	3.5	13.2	98.9	1.3	23	7.1	120	28	68
Do	do	Feb. 28, 1940	12,700	4.5	12.4	95.5	2.4	150	7.4	18	33	
Do	do	Mar. 14, 1940	8,050	4.5	11.9	91.8	2.6	93	7.3	18	31	84
Do	do	Feb. 28, 1941		1.0	12.2	85.8	5.6	75	8.1			
Big Coal River, water intake above Whiteville, W. Va.	KBi 97	May 13, 1941	10	13.0	10.1	95.2	.5	23	7.3		36	
Do	do	May 16, 1941	8	16.0	10.0	100.1	.5	21	7.3		37	
Do	do	May 21, 1941	10	15.0	9.3	91.2	1.1	43	6.9		16	
Big Coal River, 1 mile below Whiteville, W. Va.	KBi 96	May 13, 1941	10	14.0	10.1	97.1	.6	23	7.3	6	34	78
Do	do	May 16, 1941	8	15.5	10.2	101.1	.5	150	7.3	9	39	87
Do	do	May 21, 1941	10	16.0	9.3	93.6	.7	23	6.9	82	19	41
Little Coal River, ½ mile above Madison, W. Va.	KBiLi 82.5	May 13, 1941	115	16.0	9.6	96.3	.4	4	7.0		20	
Do	do	May 16, 1941	94	17.0	9.2	95.0	.5	9	6.9		18	
Do	do	May 21, 1941	107	22.0	8.7	98.3	.4	4	7.0		20	
Little Coal River, ¾ mile below Danville, W. Va.	KBiLi 80	May 13, 1941	115	15.0	9.7	95.7	.4	93	6.9	8	20	43
Do	do	May 16, 1941	94	17.5	10.0	103.3	.7	240	7.0	2	17	48
Do	do	May 21, 1941	107	20.5	9.5	104.7	.7	93	7.2	3	21	45
Coal River, 3½ miles above St. Albans, W. Va.	KBi 49	Dec. 6, 1939	31	6.0	11.2	89.4	.8	4	7.3	8	65	
Do	do	Dec. 8, 1939	28	4.5	11.4	88.2	1.4	4	7.3	8	65	
Do	do	Feb. 13, 1940	656	5.0	12.0	93.4	.3	23	6.9	70	24	85
Do	do	Feb. 28, 1940	910	4.0	12.8	97.4	.5	9	6.6	78	19	
Do	do	Mar. 14, 1940	420	5.0	12.4	96.5	.4	4	6.5	8	18	72
Coal River, waterworks intake, St. Albans, W. Va.	KBi 46	Dec. 6, 1939	31	7.5	4.2	35.4	4.8	36	7.1	12	69	164
Do	do	Dec. 8, 1939	28	7.0	4.7	38.5	2.4	7	7.1	11	70	
Do	do	Feb. 13, 1939	656	3.0	12.6	93.1	1.1	4	7.0	135	28	88
Do	do	Feb. 28, 1939	910	4.0	12.7	96.9	.4	4	6.3	25	16	
Do	do	Mar. 14, 1939	420	5.0	12.4	97.2	.4	4	6.4	4	16	76
Kanawha River, waterworks intake, Nitro, W. Va.	K 43.6	Jan. 29, 1939	1,830	0	11.6	79.5	7.3	93	7.1	15	46	
Do	do	Jan. 31, 1939	2,550	2.0	11.1	80.1	6.8	43	7.5	18	48	
Do	do	Feb. 20, 1939	26,900	3.0	12.3	91.0	1.7	93	6.9	85	21	
Armour Creek, ½ mile above mouth, Nitro, W. Va.	KAr 44.5	Jan. 29, 1939	([2])	2.0	.5	3.7	57.8	4,600	6.9	50	95	

[2] Less than 1.

TABLE K-7.—*Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Armour Creek, sewage outfall, Nitro, W. Va.	KAr 43.6	Feb. 20, 1939	31	5.0	7.8	61.0	25.9	2,400	6.9	110	50	
Kanawha River, 5 miles below Nitro, W. Va.	K 38.2	Jan. 29, 1939	1,830	0	12.2	83.4	5.1	15	7.2	14	46	
Kanawha River, United States lock, Winfield, W. Va.	K 31.1	Dec. 6, 1939	1,860	9.5	2.0	17.1	5.8	360	7.0	6	65	208
Do	do	Dec. 8, 1939	2,280	9.0	3.4	29.2	2.5	4	7.0	8	66	
Do	do	Dec. 14, 1939	3,020	7.5	3.8	31.4	4.1	7	6.9	6	67	
Do	do	Jan. 4, 1940	1,430	2.5	9.5	69.8	2.5	43	7.0	8	44	
Do	do	Jan. 10, 1940	1,830	1.5	7.6	54.1	4.6	9	6.9	10	47	
Do	do	Jan. 18, 1940	6,570	2.5	7.2	53.1	7.6	75	7.2	17	55	
Do	do	Jan. 29, 1940	1,840	.5	10.7	74.4	3.1	21	7.0	13	49	
Do	do	Feb. 13, 1940	4,490	4.0	12.8	97.5	2.1	43	7.3	95	28	
Do	do	Feb. 28, 1940	16,700	6.0	12.4	99.4	2.4	240	6.9	27	30	
Do	do	Mar. 14, 1940	8,600	4.5	11.9	91.5	1.9	150	6.8	16	26	80
Hurricane Creek, below Hurricane, W. Va.	KH 38	Mar. 28, 1940		10.0	10.3	91.2	.8	150	6.7	25	35	
Do	do	Apr. 4, 1940		12.5	9.5	88.8	.8	43	6.9	47	25	
Do	do	Aug. 15, 1940	3,140	26.0	7.1	86.3	1.5	15	7.2	24	28	
Do	do	Aug. 17, 1940	4,570	26.0	5.0	60.9	2.8	2	7.2	32	28	
Do	do	Aug. 21, 1940	8,400	26.5	4.4	54.2	1.6	2	7.2	8	36	
Do	do	Aug. 23, 1940	6,150	25.5	4.1	49.2	1.4	4	7.4	4	39	
Do	do	Aug. 29, 1940	3,290	25.5	5.0	59.8	1.0	1	7.4	6	50	
Do	do	Aug. 31, 1940	2,940	25.0	5.4	64.1	1.6	2	7.4	11	51	
Do	do	Sept. 6, 1940	2,500	24.5	5.6	66.8	1.1	1	7.4	8	48	
Do	do	Sept. 12, 1940	2,060	24.5	6.0	70.8	1.0	1	7.5	7	51	
Do	do	Sept. 14, 1940	2,050	25.5	6.2	75.2	.8	2	7.6	7	53	
Do	do	Sept. 18, 1940	1,790	24.0	5.8	67.8	.6	1	7.5	5	50	
Do	do	Sept. 20, 1940	1,710	23.5	6.1	70.6	.8	2	7.5	5	49	
Do	do	Sept. 26, 1940	1,700	23.5	6.6	76.4	.6	(2)	7.5	4	50	
Do	do	Sept. 28, 1940	1,710	23.0	6.6	75.4	.8	(2)	7.6	4	49	
Do	do	Oct. 2, 1940	2,550	20.5	6.7	73.8	.9	4	7.4	9	44	
Do	do	Oct. 4, 1940	1,900	19.5	7.0	76.1	.8	(2)	7.7	8	47	
Do	do	Oct. 10, 1940	1,940	21.0	6.5	72.3	.7	2	7.7	6	47	
Do	do	Oct. 12, 1940	1,590	20.0	6.7	73.4	.7	(2)	7.5	7	44	
Do	do	Oct. 16, 1940	1,650	18.0	7.4	77.5	.6	5	7.4	8	48	
Do	do	Oct. 18, 1940	1,780	16.5	7.5	75.8	.7	4	7.4	6	46	
Do	do	Oct. 24, 1940	1,610	15.5	7.7	76.5	.7	4	7.3	4	50	

Do	do	Oct. 26, 1940	1,540	17.0	7.6	78.1	.7	4	7.5	4	47	----------
Do	do	Oct. 30, 1940	1,900	13.5	8.2	78.2	.8	4	7.3	14	44	----------
Do	do	Nov. 1, 1940	2,130	13.0	7.8	73.9	.9	1	7.4	8	56	----------
Do	do	Nov. 7, 1940	2,100	11.0	8.5	76.7	.8	2	7.2	12	53	----------
Do	do	Nov. 9, 1940	2,150	9.0	8.5	73.6	.9	1	7.2	12	56	----------
Do	do	Nov. 13, 1940	1,800	7.0	8.9	73.3	.7	2	7.0	7	57	----------
Do	do	Nov. 15, 1940	1,600	7.5	8.8	73.1	1.3	2	7.1	6	55	----------
Do	do	Nov. 21, 1940	1,720	8.5	8.6	73.7	1.1	9	7.4	7	60	----------
Do	do	Nov. 27, 1940	1,980	5.0	8.4	65.6	.8	1	7.1	6	61	----------
Do	do	Nov. 29, 1940	1,860	5.5	8.4	66.3	.9	2	7.2	8	61	----------
Kanawha River, B. & O. R. R. bridge.	K 0.6	Dec. 5, 1939	2,090	5.0	7.2	56.3	.3	(2)	7.2	5	61	----------
Do	do	Dec. 7, 1939	2,550	5.0	6.9	53.8	.8	1	7.1	3	61	----------
Do	do	Dec. 11, 1939	2,450	5.5	7.1	55.9	1.0	(2)	7.0	5	65	----------
Do	do	Dec. 13, 1939	3,170	5.5	6.9	54.7	1.0	1	7.1	6	67	----------
Do	do	Dec. 19, 1939	2,650	6.0	6.8	54.5	1.1	1	7.1	6	67	----------
Do	do	Dec. 21, 1939	5,110	5.0	7.0	54.4	1.6	1	7.2	6	65	----------
Do	do	Dec. 27, 1939	3,130	3.0	6.5	48.5	2.6	2	7.0	8	60	----------
Do	do	Jan. 2, 1940	2,570	2.5			1.6	2	7.1	5	59	----------
Do	do	Jan. 4, 1940	1,530	2.0	8.2	59.3	2.3	(2)	7.1	6	59	----------
Do	do	Jan. 8, 1940	2,000	2.0	9.7	70.3	2.4	1	7.1	7	55	----------
Do	do	Jan. 10, 1940	2,000	2.0	10.3	74.2	2.7	(2)	7.0	7	50	----------
Do	do	Jan. 16, 1940	7,930	1.0	10.8	76.1	3.5		6.9	200	46	----------
Do	do	Feb. 15, 1940	29,500	2.0	13.2	85.3	2.1	9	7.1	180	25	----------
Do	do	Feb. 19, 1940	22,700	2.5	13.0	95.1	2.3	43	6.8	270	22	----------
Do	do	Feb. 21, 1940	41,000	2.5	12.7	92.9	2.2	15	7.0	160	23	----------
Do	do	Feb. 27, 1940	11,700	2.5	12.5	91.6	1.5	43	7.0	36	29	----------
Do	do	Feb. 29, 1940	25,300	2.5	12.3	90.1	2.2	150	7.0	65	30	----------
Do	do	Mar. 4, 1940	39,300	5.0	12.0	94.0	1.5	36	7.1	190	32	----------
Do	do	Mar. 6, 1940	45,900	5.0	11.4	89.2	1.6	28	7.3	80	29	----------
Do	do	Mar. 12, 1940	9,100	4.5	12.1	93.2	1.8	93	7.0	31	26	----------
Do	do	Mar. 14, 1940	9,270	5.0	11.8	91.8	1.0	7	6.9	16	23	----------
Do	do	Mar. 18, 1940	8,540	5.5	11.3	89.7	1.7	9	7.0	8	33	----------
Do	do	Mar. 20, 1940	22,000	7.0	11.0	90.1	2.1	23	6.8	100	29	----------
Do	do	Mar. 26, 1940	8,320	5.0	11.1	86.7	1.0	43	6.8	9	24	----------
Do	do	Apr. 1, 1940	49,100	7.0	10.4	85.8	2.3	93	7.0	200	25	----------
Do	do	Apr. 3, 1940	32,800	7.0	10.4	85.2	1.0	460	7.2	70	18	----------
Do	do	Apr. 9, 1940	16,200	10.0	9.3	82.3	1.3	23	6.7	18	22	----------
Do	do	Apr. 11, 1940	24,200	11.0	9.5	86.1	1.8	23	6.7	38	28	----------

[1] Seeded and neutralized.
[2] Less than 1.

LITTLE KANAWHA RIVER BASIN

CONTENTS

	Page
Contents	525
Syllabus and conclusions	527
Description	528
Presentation of field data	528
Presentation of laboratory data	530
Hydrometric data	531

LIST OF TABLES

Lk–1.—Cost estimates of remedial measures	528
Lk–2.—Surface-water supplies	529
Lk–3.—Sources of pollution	529
Lk–4.—Industrial wastes (omitted; not significant).	
Lk–5.—Selected laboratory data	530
Lk–6.—Monthly mean summer flows	531
Lk–7.—Summary of laboratory data	532

LIST OF FIGURES

Lk–2. Chart—Sources of pollution and selected laboratory data	528

(Note.—For maps of this basin see Kanawha River Basin.)

LITTLE KANAWHA RIVER BASIN [1]

Syllabus and Conclusions

SYLLABUS

The Little Kanawha Basin comprises 2,320 square miles of mountainous country in west central West Virginia. The total population is about 90,000 and there are no communities with as many as 2,500 people. The two largest communities have sewage-treatment plants. There are no pollution problems that cannot be solved by available methods of waste treatment.

CONCLUSIONS

(1) Sewage from 10,200 is discharged to the Little Kanawha River and its tributaries. About 45 percent of the sewage is treated. No industrial wastes enter the stream.

(2) Three public water supplies are taken from streams below sources of pollution.

(3) Primary treatment of sewage now discharged without treatment should be sufficient to maintain good oxygen conditions in the streams.

(4) A summary of cost estimates of remedial measures from table Lk–1 follows:

Treatment	Capital cost	Annual charges
Existing	$190,000	$15,000
Suggested additional	210,000	20,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	$210,000	$20,000
Secondary, all places	290,000	25,000

[1] For maps of this basin, see Kanawha River Basin.

TABLE LK–1.—*Little Kanawha River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes with comparative costs for primary and secondary treatment.*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	1	1	4,800	$190,000	$12,000	$3,000	$15,000
Suggested minimum treatment:							
Sewage treatment plants	6	0	5,309	90,000	10,000	5,000	15,000
Required interceptors				120,000	5,000		5,000
Independent industrial waste correction							
Total				210,000	15,000	5,000	20,000
Comparative cost:							
Primary treatment all waste				210,000	15,000	5,000	20,000
Secondary treatment all waste				290,000	18,000	7,000	25,000
As suggested				210,000	15,000	5,000	20,000

DESCRIPTION

The Little Kanawha River drains 2,320 square miles of mountainous country in the west central part of West Virginia and joins the Ohio River at Parkersburg, W. Va. Most of the area is covered with second-growth timber. A little coal is mined in the eastern part of the basin, and some oil and gas is produced but production is declining. Farming is the principal occupation. The area is sparsely populated and the population has not changed greatly during the past 40 years.

Year	Population	Year	Population
1910	90,441	1930	86,133
1920	86,797	1940	92,355

All of the population is classed as rural, the largest community, Spencer, having a population of 2,497 in 1940. There are 7 other communities with more than 500 people.

The principal tributary is Hughes River, which joins the Little Kanawha at mile 19 and drains 530 square miles.

Water uses.—Five locks and dams maintain a navigable channel for boats of 4-foot draft as far as Creston, 48 miles above the mouth. The facilities are not used extensively. The Little Kanawha from Creston to Falls Mills and both forks of Hughes River are considered good bass fishing streams and are extensively used for sport fishing. The State of West Virginia maintains a bass hatchery at Palestine.

PRESENTATION OF FIELD DATA

Figure K–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure Lk–2 shows similar data and, in addition, the location of water-supply intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

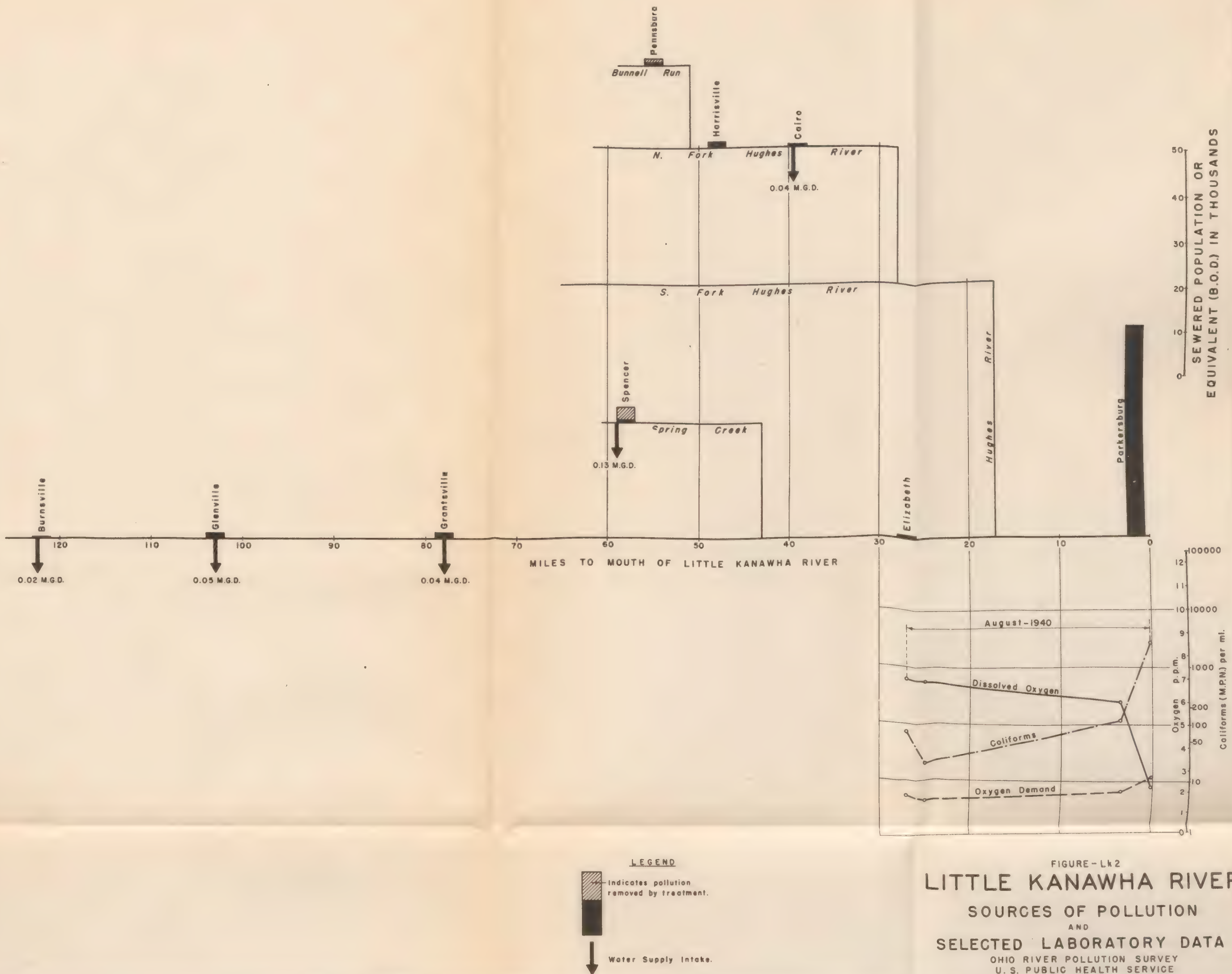


FIGURE-Lk2

LITTLE KANAWHA RIVER

SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Public water supplies.—Of the 8 public water supplies in the basin, 5 are from surface sources. These serve 6,600 people, about two-thirds of the total population served by water supplies. Three of the surface supplies are from streams subject to pollution. Table Lk–2 shows data on the surface supplies.

TABLE LK–2.—*Little Kanawha River Basin: Surface water supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
Grantsville	West Virginia.	Little Kanawha River	78	FD	1,000	0.04
Glenville	do	do	103	FD	1,400	.05
Cairo	do	North Fork, Hughes River	39.5	CD	500	.04
	Other surface supplies					
Burnsville	West Virginia.	North Fork, Hughes River	122.5	D	400	0.02
Spencer	do	Impounded and Spring Creek	59	FD	3,500	.13
Total:						
Below sewer outfalls					2,900	0.13
Other					3,700	.15
Total surface water supplies					6,600	.28

[1] Miles above mouth of Little Kanawha River.
[2] F=Coagulated, settled, filtered; D=Chlorinated; C=Coagulated, settled.

Sewerage.—Table Lk–3 shows the sewered population at each source of pollution. Of the 10,200 people connected to sewers, 4,800 are served by the two sewage-treatment plants.

Industrial wastes.—There are no sources of industrial wastes in the basin except at Parkersburg, at the mouth. The problem of these wastes is considered with other Ohio River problems.

TABLE LK–3.—*Little Kanawha River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalents (biochemical oxygen demand)*

Municipality	State	Receiving stream	Mile [1]	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Elizabeth	West Virginia.	Little Kanawha River	27	600	None	600	600
Grantsville	do	do	78	1,300	do	1,300	1,300
Glenville	do	do	103	1,300	do	1,300	1,300
Burnsville	do	do	122	300	do	300	300
Cairo	do	North Fork Hughes River	39	500	do	500	500
Harrisville	do	do	48	1,300	do	1,300	1,300
Pennsboro	do	Bunnell Run	55	1,400	Primary	1,400	900
Reedy	do	Reedy Creek	44	100	None	100	100
Spencer	do	Spring Creek	58	3,400	Secondary [2]	3,400	500
Total				10,200		10,200	6,800

[1] Miles above mouth of Little Kanawha River.
[2] Treatment plant under construction at time of laboratory survey.

Presentation of Laboratory Data

Laboratory results for the Little Kanawha River Basin are summarized in table Lk–7 (p. 532). Selected data are shown in table Lk–5. All observations were made by the laboratory boat *Kiski* during the 5-month period from May to September 1940. Ten points were sampled from one to four times monthly. Maps showing the most unfavorable monthly averages of the coliform, dissolved oxygen and oxygen demand results are shown on figures K–3, K–4, and K–5 (p. 500.)

Table Lk–5.—*Little Kanawha River Basin: Selected laboratory data, main stream and tributaries*

River	Little Kanawha	Little Kanawha	Little Kanawha	Little Kanawha	Bunnell Run
Location	At mouth	Above Parkersburg	Above Elizabeth	Below Elizabeth	Below Pennsboro
River miles above mouth of Little Kanawha	0.1	3.5	27	25	63
Period, 1940	August	August	September	September	July
Number of samples	11	4	3	3	3
Flow in cubic feet per second: Sampling days	671	1,449	45	45	1
Water temperature °C	25.7	26.8	22.0	22.5	21.5
Coliforms per milliliter	2,720	117	12	28	7,130
Dissolved oxygen, parts per million	2.2	6.0	7.2	7.0	3.7
Biochemical oxygen demand, 5-day, parts per million	2.7	2.0	1.6	3.4	15.8

River	North Fork Hughes	North Fork Hughes	North Fork Hughes	Spring Creek	Spring Creek
Location	Above Harrisville	Below Harrisville	Water intake Cairo	Above Spencer	Below Spencer
River miles above mouth of Little Kanawha	49	47	40.5	58.5	56.5
Period, 1940	August	August	August	August	August
Number of samples	4	4	4	4	4
Flow in cubic feet per second: Sampling days	24	24	39	23	23
Water temperature °C	23.1	23.0	23.6	22.8	22.8
Coliforms per milliliter	154	70	218	116	3,350
Dissolved oxygen, parts per million	6.2	5.9	6.0	4.0	1.7
Biochemical oxygen demand, 5-day, parts per million	1.3	1.3	1.3	1.8	5.4

The results for May to July are representative of moderately high discharges and those of August and September are representative of moderately low discharge conditions in the basin. High coliform counts were observed at all stations for at least 1 month. The highest counts were observed below Spencer and Pennsboro and at the mouth. The latter station showed the influence of Parkersburg's sewage. The dissolved oxygen results were generally better than 6.0 parts per million except below Spencer and Pennsboro and at Parkersburg where low monthly averages of about 2.0 parts per million were observed at times. Oxygen-demand observations were generally less than 2.0 parts per million and rarely exceeded 3.0 parts per million except below Pennsboro and Spencer where highs of about 16 parts per million and 5.0 parts per million respectively were observed. Except for more or less uniformly high coliform counts, the Little Kanawha Basin does not appear to have any extensive pollution problem.

Biological summary.—The plankton population of the Little Kanawha is quite variable with a tendency to low values. Pollution near the mouth depletes the dissolved oxygen and as a result no fish life exists in this section.

Hydrometric Data

Six stream-gaging stations are currently in operation in the Little Kanawha Basin. Table Lk–6 shows monthly mean summer flows for 3 of the driest years of record at four of these stations.

Table Lk–6.—*Little Kanawha River Basin: Monthly mean summer flows for years in which lowest summer flows have occurred*

River	Little Kanawha,	Little Kanawha,	Little Kanawha,	Hughes
Location	Glenville, W. Va.	Grantsville, W. Va.	Palestine, W. Va.	Cisko, W. Va.
River miles above mouth of Little Kanawha	103	80	31	28
Drainage area ... square miles	386	913	1,513	453
Period of record	1929–40	1929–40	[1] 1912–40	1915–31, 1939–40
Year	1930	1930	1925	1930
June ... cubic feet per second	23.9	34.1	1,170	5.72
July ... do	5.92	7.22	2,520	1.01
August ... do	1.75	5.18	318	.12
September ... do	0.01	0.21	0	.01
Year	1932	1932	1930	1939
June ... cubic feet per second	43.4	130	8	235
July ... do	337	1,150	7	377
August ... do	27.8	52.4	7	88.3
September ... do	5.5	12.9	7	6.99
Year	1939	1939	1937	1925
June ... cubic feet per second	55.5	152	7	84
July ... do	197	434	7	205
August ... do	83.9	188	117	26
September ... do	11.6	16.9	11	14

[1] Accuracy of record fair to poor 1912–37; fair 1938–40.

Proposed stream control.—The United States Engineer Department has determined three reservoir sites to be most nearly satisfactory for flood control storage development; Burnsville on the Little Kanawha River at mile 122.6,[1] Steer Creek on Steer Creek at mile 85.3,[1] and West Fork on West Fork at mile 50.1.[1] Under the proposed plans of operation, the minimum seasonal flows which could be maintained are 10 cubic feet per second, 7 cubic feet per second, and 10 cubic feet per second, respectively. Although increased stream discharge will be beneficial, it is not sufficient to cause any reduction in the sewage treatment required. Hence, the low-flow control which could be provided by the projected reservoirs would have slight tangible value.

The Little Kanawha River is only moderately polluted. The largest community, Spencer, has recently installed a secondary sewage treatment plant, and the second largest one, Pennsboro, has a primary treatment plant which needs some improvements. Primary treatment should be sufficient to maintain good stream conditions at the remaining sources of pollution, except during such an extremely dry year as 1930. Provision against such a remote contingency does not seem justified. Low-flow augmentation by the proposed flood control reservoirs would have no appreciable tangible value.

The estimated cost of the suggested pollution abatement program is summarized on table Lk–1, together with the estimated cost of existing works and of a program for secondary treatment of all wastes.

[1] River miles above mouth of Little Kanawha River.

TABLE LK-7—*Little Kanawha River Basin: Ohio River Pollution Survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Spring Creek, above Spencer, W. Va., bridge on route No. 36.	LkS 58.5	June 3, 1940	15	21.0	6.9	76.5	1.0	43	6.9	27	48	
Do	do	June 12, 1940	93	23.0	7.1	81.5	3.9	1,100	6.8	750	37	
Do	do	June 20, 1940	27	21.0	6.3	70.1	.5	91	7.0	43	52	
Do	do	June 28, 1940	144	20.0	8.6	93.3	.7	43	7.0	45	30	
Do	do	July 9, 1940	3	21.5	5.2	58.5	1.5	43	6.8	19	60	
Do	do	July 17, 1940	6	21.5	4.6	52.1	1.4	43	7.1	25	61	
Do	do	July 25, 1940	416	24.0	5.3	61.8	3.2	930	6.9	1,050	40	
Do	do	Aug. 2, 1940	16	23.0	4.2	48.5	1.2	0	7.1	51	57	
Do	do	Aug. 12, 1940	3	24.0	3.2	37.3	1.4	9	7.1	35	71	
Do	do	Aug. 20, 1940	1	21.0	1.9	21.4	2.4	24	7.0	23	80	
Do	do	Aug. 28, 1940	70	23.0	6.7	77.2	2.3	430	7.1	410	33	
Do	do	Sept. 5, 1940	4	21.0	5.4	60.5	.7	91	7.2	47	57	
Do	do	Sept. 13, 1940	1	14.0	6.2	60.1	.6	23	6.7	14	64	
Do	do	Sept. 17, 1940	1	16.5	5.2	53.0	1.0	4	6.4	12	64	
Spring Creek, 1½ miles below Spencer, W. Va.	LkS 56.5	June 3, 1940	15	20.5	.2	2.3	3.5	1,100	6.9	36	56	
Do	do	June 12, 1940	93	22.5	3.9	44.9	4.1	1,100	6.8	1,600	34	
Do	do	June 20, 1940	27	23.0	.7	8.1	3.3	2,400	7.0	29	65	
Do	do	June 28, 1940	144	19.5	7.4	80.2	1.1	430	7.0	69	32	
Do	do	July 9, 1940	3	22.0	2.9	32.7	2.9	36	7.0	13	80	
Do	do	July 17, 1940	6	22.5	2.0	23.1	3.8	150	7.1	12	84	
Do	do	July 25, 1940	416	24.0	3.6	42.1	3.9	1,500	6.8	1,100	44	
Do	do	Aug. 2, 1940	16	24.5	.1	1.7	6.8	11,000	7.0	105	90	
Do	do	Aug. 12, 1940	3	24.0	.7	8.2	6.4	0	7.2	28	114	
Do	do	Aug. 20, 1040	1	21.5	.7	7.7	4.8	0	7.1	14	157	
Do	do	Aug. 28, 1940	70	22.5	5.4	62.2	3.6	2,400	7.0	710	37	
Do	do	Sept. 5, 1940	4	20.0	.7	7.5	3.1	230	6.9	13	78	
Do	do	Sept. 13, 1940	1	15.0	1.6	16.0	2.7	9	6.7	15	102	
Do	do	Sept. 17, 1940	1	16.5	4.2	42.7	4.4	9	6.5	13	115	
Little Kanawha River, 1 mile above Elizabeth, W. Va.	Lk 27	June 3, 1940	3,020	19.0	9.3	99.4	1.3	23	7.0	66	20	
Do	do	June 12, 1940	1,620	26.0	7.6	92.2	1.3	93	6.9	115	30	
Do	do	June 20, 1940	10,100	21.0	8.5	94.7	1.9	93	7.0	820	23	
Do	do	June 28, 1940	2,790	22.0	8.5	95.9	1.4	15	7.1	125	30	
Do	do	July 9, 1940	104	26.5	8.4	103.0	1.0	4	7.1	15	32	
Do	do	July 17, 1940	262	25.0	7.8	93.4	1.4	4	7.3	8	32	
Do	do	July 25, 1940	8,250	26.5	7.9	97.2	2.2	110	6.9	555	30	
Do	do	Aug. 2, 1940	1,280	26.0	7.0	85.8	1.8	240	7.0	500	28	
Do	do	Aug. 12, 1940	71	29.0	7.6	97.3	2.4	4	7.1	41	33	

Do	do	Aug. 20, 1940	16	25.5	6.3	75.9	1.4	9	7.4	24	41	
Do	do	Aug. 28, 1940	1,120	25.0	7.1	84.7	1.6	43	7.1	81	44	
Do	do	Sept. 5, 1940	75	25.0	7.1	84.4	1.9	24	7.1	46	38	
Do	do	Sept. 13, 1940	35	19.0	7.0	74.7	1.6	8	6.9	40	37	
Do	do	Sept. 17, 1940	25	22.0	7.4	84.3	1.4	4	6.9	17	36	
Little Kanawha River, below dam No. 3, Elizabeth, W. Va.	Lk 25	June 3, 1940	3,020	18.0	9.5	99.4	1.2	240	7.0	95	20	
Do	do	June 12, 1940	1,620	26.0	7.5	91.3	1.5	43	7.1	95	26	
Do	do	June 20, 1940	10,100	21.0	8.1	90.2	1.4	93	6.9	950	22	
Do	do	June 28, 1940	2,790	22.0	8.1	91.4	.8	43	7.2	172	30	
Do	do	July 9, 1940	104	26.0	9.5	115.9	1.6	43	7.1	16	32	
Do	do	July 17, 1940	262	24.0	7.9	92.6	1.4	9	7.2	8	32	
Do	do	July 25, 1940	8,250	26.0	7.6	92.6	1.7	240	6.9	460	31	
Do	do	Aug. 2, 1940	1,280	27.0	6.9	85.9	1.2	20	7.1	255	31	
Do	do	Aug. 12, 1940	71	28.0	7.6	95.5	2.0	15	7.4	51	33	
Do	do	Aug. 20, 1940	16	26.0	6.3	77.1	1.4	4	7.2	18	37	
Do	do	Aug. 28, 1940	1,120	25.5	6.6	79.5	1.6	43	7.0	50	48	
Do	do	Sept. 5, 1940	75	25.0	7.7	92.0	7.0	23	7.2	74	34	
Do	do	Sept. 13, 1940	35	21.0	6.4	70.8	1.2	14	6.8	34	36	
Do	do	Sept. 17, 1940	25	21.5	7.0	79.0	2.0	46	6.9	16	35	
Bunnell Run, below city limits, Pennsboro, W. Va.	LkHNfB 83	May 31, 1940	25	17.0	9.1	93.8	1.6	110	6.5	33	31	
Do	do	June 10, 1940	2	26.0	9.4	114.7	1.5	46	7.6	19	76	
Do	do	June 19, 1940	13	19.0	8.8	93.6	.6	93	7.0	17	40	
Do	do	June 27, 1940	1	18.5	9.0	95.3	.8	240	7.4	11	77	
Do	do	July 8, 1940	(1)	20.0	4.9	53.0	1.4	1,100	6.9	8	89	
Do	do	July 16, 1940	(1)	20.0	0	0	39.0	11,000	7.0	55	263	
Do	do	July 24, 1940	2	24.5	6.3	74.3	6.9	9,300	7.1	175	86	
Do	do	Aug. 1, 1940	2	20.5	5.8	63.5	5.3	4,300	7.1	180	101	
Do	do	Aug. 9, 1940	(1)	22.0	5.4	61.0	5.5	4,300	7.1	17	115	
Do	do	Aug. 19, 1940	(1)	21.0	6.4	71.5	6.1	2,300	7.1	475	69	
Do	do	Aug. 27, 1940	1	21.0	7.3	80.8	7.3	46,000	7.0	56	75	
Do	do	Sept. 4, 1940	1	18.0	9.5	99.5	.8	0	6.9	10	81	
Do	do	Sept. 12, 1940	(1)	15.0	4.0	39.4	21.9	11,000	6.7	14	136	
North Fork, Hughes River, bridge above Harrisville, W. Va.	LkHNf 49	May 31, 1940	677	17.0	9.3	95.3	1.5	46	6.7	115	21	
Do	do	June 10, 1940	50	23.5	6.8	79.2	1.8	110	7.4	410		
Do	do	June 19, 1940	362	21.0	7.9	87.5	.9	43	7.1	86	39	
Do	do	June 27, 1940	28	19.0	7.2	77.2	.5	9	7.5	30	43	
Do	do	July 8, 1940	8	21.5	7.4	83.6	.4	9	7.2	15	53	
Do	do	July 16, 1940	5	22.0	6.7	75.8	1.5	8	7.2	8	55	
Do	do	July 24, 1940	40	25.0	5.6	66.3	1.6	9	7.1	250	52	
Do	do	Aug. 1, 1940	65	23.0	6.0	68.7	.7	23	7.1	19	48	
Do	do	Aug. 9, 1940	10	24.5	6.1	72.6	1.2	23	7.5	19	46	
Do	do	Aug. 19, 1940	2	22.5	6.1	69.3	1.0	110	7.2	28	50	
Do	do	Aug. 27, 1940	18	22.5	6.6	75.7	2.4	460	7.2	480	31	
Do	do	Sept. 4, 1940	24	20.0	7.4	80.6	.4	23	7.2	24	45	
Do	do	Sept. 12, 1940	3	15.0	8.5	83.4	.8	4	6.9	14	49	

[1] Less than 1.

TABLE LK-7—*Little Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
North Fork, Hughes River, ¾ mile below Harrisville.	LkHNf 47	May 31, 1940	677	15.5	9.2	91.7	1.1	46	6.7	160	21	----------
Do	do	June 10, 1940	50	23.5	5.5	64.3	2.7	110	7.4	1,020	----------	----------
Do	do	June 19, 1940	362	21.0	7.7	85.2	.9	240	7.1	115	28	----------
Do	do	June 27, 1940	28	20.0	7.4	80.6	.6	15	7.4	39	43	----------
Do	do	July 8, 1940	8	21.5	6.8	76.3	.4	24	7.2	19	54	----------
Do	do	July 16, 1940	5	22.0	6.1	68.7	1.1	15	7.3	15	51	----------
Do	do	July 24, 1940	40	25.0	6.2	73.7	1.1	21	7.3	25	56	----------
Do	do	Aug. 1, 1940	65	23.0	5.4	62.5	.8	9	7.1	42	53	----------
Do	do	Aug. 9, 1940	10	24.0	6.4	74.8	1.2	8	7.5	19	50	----------
Do	do	Aug. 19, 1940	2	22.5	5.0	57.7	1.0	24	7.2	15	49	----------
Do	do	Aug. 27, 1940	18	22.5	6.9	78.5	2.2	240	7.2	220	34	----------
Do	do	Sept. 4, 1940	24	20.0	7.2	78.0	.6	23	7.1	31	44	----------
Do	do	Sept. 12, 1940	3	15.0	7.6	75.0	.6	2	6.9	15	47	----------
North Fork Hughes River, raw water intake, Cairo, W. Va.	LkHNf 40.5	May 31, 1940	1,100	14.5	9.1	88.3	2.5	110	6.7	230	22	----------
Do	do	June 10, 1940	82	22.5	6.9	79.3	3.0	460	7.3	830	30	----------
Do	do	June 19, 1940	588	22.0	7.8	88.9	.6	73	7.1	87	28	----------
Do	do	June 27, 1940	46	20.5	7.2	78.7	.5	43	7.4	50	40	----------
Do	do	July 8, 1940	13	22.0	7.4	83.8	.7	93	7.2	19	50	----------
Do	do	July 16, 1940	8	22.0	7.3	83.0	1.2	23	7.3	13	51	----------
Do	do	July 24, 1940	65	25.0	5.6	66.5	1.0	23	7.3	12	55	----------
Do	do	Aug. 1, 1940	106	23.5	4.5	52.3	1.1	110	7.0	47	47	----------
Do	do	Aug. 9, 1940	16	24.5	6.5	76.8	1.3	93	7.5	74	44	----------
Do	do	Aug. 19, 1940	4	23.0	6.3	73.0	1.1	240	7.8	14	50	----------
Do	do	Aug. 27, 1940	28	23.5	6.7	77.7	1.7	430	7.2	169	41	----------
Do	do	Sept. 4, 1940	38	21.5	7.0	79.1	.5	36	7.1	50	42	----------
Do	do	Sept. 12, 1940	4	16.0	8.1	81.5	.7	46	6.9	15	47	----------
Little Kanawha River, dam No. 1, above Parkersburg, W. Va.	Lk 3.5	June 3, 1940	7,740	18.0	9.4	98.5	1.6	43	6.7	78	19	----------
Do	do	June 12, 1940	2,370	25.0	7.2	85.7	2.7	460	7.2	55	32	----------
Do	do	June 20, 1940	12,300	21.5	7.9	88.7	1.4	210	6.9	590	25	----------
Do	do	June 28, 1940	1,850	23.0	7.8	89.8	.8	9	7.2	88	31	----------
Do	do	July 9, 1940	232	27.0	8.7	108.0	2.1	2	7.1	18	32	----------
Do	do	July 17, 1940	450	25.0	9.6	114.5	2.1	2	7.4	8	32	----------
Do	do	July 25, 1940	9,600	27.5	7.5	93.6	1.1	75	7.0	115	34	----------
Do	do	Aug. 2, 1940	3,020	28.0	7.4	94.1	1.2	4	7.1	98	30	----------
Do	do	Aug. 12, 1940	167	29.5	6.9	89.2	2.7	2	7.4	119	30	----------
Do	do	Aug. 20, 1940	19	24.5	4.4	52.7	1.5	2	7.2	119	33	----------

Do	do	Aug. 28, 1940	2,590	25.0	5.4	64.2	2.8	460	6.8	395	38	
Do	do	Sept. 5, 1940	207	25.0	7.5	89.5	2.0	43	7.2	58	39	
Do	do	Sept. 13, 1940	57	21.0	6.0	67.1	1.4	4	6.8	39	39	
Do	do	Sept. 17, 1940	41	20.5	5.7	63.1	1.5	4	6.9	52	40	
Little Kanawha River, Baltimore & Ohio Railroad bridge.	Lk 0.1	May 2, 1940	1,080	12.5	9.1	85.3	3.7	230	6.6	34	19	
Do	do	May 8, 1940	705	15.0	8.8	86.3	3.5	460	6.7	18	23	
Do	do	May 10, 1940	600	15.0	7.9	77.4	3.7	240	6.7	18	20	
Do	do	May 14, 1940	352	16.5	6.6	66.9	2.5	460	6.8	11	27	
Do	do	May 16, 1940	225	16.5	7.9	80.2	2.7	230	7.1	75	27	
Do	do	May 20, 1940	292	17.5	7.3	75.5	2.5	430	6.9	14	20	
Do	do	May 22, 1940	897	18.5	6.9	73.2	3.8	11,000	6.5	7	25	
Do	do	May 24, 1940	1,080	19.0	7.0	74.5	2.9	910	6.5	30	29	
Do	do	May 28, 1940	3,140	19.5	8.4	90.2	1.1	0	6.9	17	28	
Do	do	June 3, 1940	4,170	16.5	9.2	93.5	1.6	1,100	6.8	170	19	
Do	do	June 5, 1940	2,270	18.5	8.0	84.7	1.8	1,100	6.9	65	20	
Do	do	June 7, 1940	1,080	21.0	6.9	77.0	2.1	2,400	6.8	53	23	
Do	do	June 11, 1940	2,180	22.5	6.5	74.3	1.9	430	7.5	470	30	
Do	do	June 13, 1940	7,750	23.5	7.3	85.1	1.8	430	7.0	480	25	
Do	do	June 17, 1940	3,480	24.5	7.2	84.6	1.4	23	7.2	350	27	
Do	do	June 19, 1940	17,700	22.0	7.9	89.1	2.1	240	7.3	400	27	
Do	do	June 21, 1940	4,050	20.5	8.3	91.2	1.2	150	7.2	530	22	
Do	do	June 25, 1940	2,760	21.5	7.3	82.2	1.9	4,600	7.0	160	26	
Do	do	June 27, 1940	3,020	22.0	7.4	84.4	1.3	2,300	7.0	208	28	
Do	do	July 1, 1940	2,060	21.5	7.4	82.8	2.1	4,300	6.7	165	27	
Do	do	July 3, 1940	1,220	21.5	7.1	79.6	1.2	230	7.0	85	34	
Do	do	July 11, 1940	357	24.5	6.6	77.5	1.6	430	6.9	19	33	
Do	do	July 15, 1940	700	23.5	4.6	53.2	2.6	1,100	7.3	15	29	
Do	do	July 17, 1940	448	23.5	5.0	57.6	2.1	930	7.2	15	30	
Do	do	July 19, 1940	675	25.5	3.3	39.4	5.1	930	6.9	12	23	
Do	do	July 23, 1940	702	27.5	4.3	54.2	1.9	230	7.0	15	33	
Do	do	July 25, 1940	9,570	26.5	6.7	82.7	1.5	230	7.1	23	38	
Do	do	July 29, 1940	1,230	28.5	6.6	84.2	1.7	1,100	6.9	87	28	
Do	do	July 31, 1940	2,920	27.5	4.2	52.2	2.2	930	6.7	175	25	
Do	do	Aug. 2, 1940	1,610	26.0	6.8	82.1	1.4	2,400	7.0	108	26	
Do	do	Aug. 6, 1940	403	28.0	5.6	70.6	1.8	430	6.9	69	33	
Do	do	Aug. 8, 1940	228	26.5	1.2	14.7	2.5	2,400	7.0	62	28	
Do	do	Aug. 12, 1940	167	27.0	2.5	30.6	2.0	930	7.1	58	31	
Do	do	Aug. 14, 1940	85	27.5	1.4	17.5	1.8	91	7.3	74	27	
Do	do	Aug. 16, 1940	48	26.5	.2	2.1	2.0	240	7.0	60	25	
Do	do	Aug. 20, 1940	19	25.5	0	0	3.9	4,600	6.9	59	30	
Do	do	Aug. 22, 1940	24	25.0	0	0	2.8	910	7.2	62	25	
Do	do	Aug. 26, 1940	18	23.5	.2	2.3	4.2	9,300	7.1	54	23	
Do	do	Aug. 28, 1940	2,590	24.0	0	0	5.6	4,300	6.7	185	24	
Do	do	Aug. 30, 1940	2,190	23.0	6.4	73.4	1.9	4,300	6.9	360	32	
Do	do	Sept. 3, 1940	560	23.5	4.6	52.9	1.9	930	7.0	150	37	
Do	do	Sept. 5, 1940	207	23.0	2.2	25.6	1.8	430	6.7	94	37	
Do	do	Jan. 14, 1941	1,000	1.5	13.3	94.6	2.4	460	6.6	25	26	
Do	do	Jan. 16, 1941	1,260	3.0	13.0	96.5	3.9	240	6.8	30	23	

TABLE LK-7—*Little Kanawha River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Little Kanawha River, Baltimore & Ohio Railroad bridge.	Lk 0.1	Jan. 20, 1941	1,700	1.0	13.1	91.8	1.9	93	7.1	50	23	....
Do	do	Jan. 24, 1941	5,120	2.5	13.0	95.0	2.2	240	6.9	120	27	....
Do	do	Jan. 28, 1941	15,600	3.0	13.1	97.2	1.6	36	6.9	210	17	....
Do	do	Jan. 30, 1941	4,830	2.0	9.0	64.7	1.4	43	6.9	150	16	....
Do	do	Feb. 3, 1941	1,520	2.0	13.4	96.8	1.6	3	6.7	30	16	....
Do	do	Feb. 5, 1941	1,220	1.5	13.4	95.9	2.2	24	6.7	25	17	....
Do	do	Feb. 7, 1941	1,140	2.0	13.1	94.7	2.4	43	7.0	20	19	....
Do	do	Mar. 7, 1941	1,190	2.0	13.4	96.9	1.6	23	7.0	18	29	....
Do	do	Mar. 11, 1941	15,000	2.0	13.6	98.3	3.1	43	7.0	190	24	....
Do	do	Mar. 13, 1941	14,400	2.0	13.1	94.4	1.8	43	6.8	480	20	....
Do	do	Mar. 17, 1941	2,130	1.5	13.0	92.6	2.2	43	7.0	85	10	....
Do	do	Mar. 19, 1941	1,530	1.5	13.4	95.2	1.9	15	6.8	35	14	....
Do	do	Mar. 21, 1941	1,430	2.5	13.3	97.3	2.2	24	6.9	25	15	....
Do	do	Mar. 25, 1941	1,130	4.0	12.4	94.4	2.3	24	6.7	18	18	....
Do	do	Mar. 27, 1941	905	5.0	12.2	95.5	3.0	240	6.7	20	19	....

[1] Less than 1.

BIG SANDY RIVER BASIN

CONTENTS

	Page
Contents	539
Syllabus and conclusions	541
Description	542
Presentation of field data	543
Presentation of laboratory data	545
Hydrometric data	547
Discussion	548

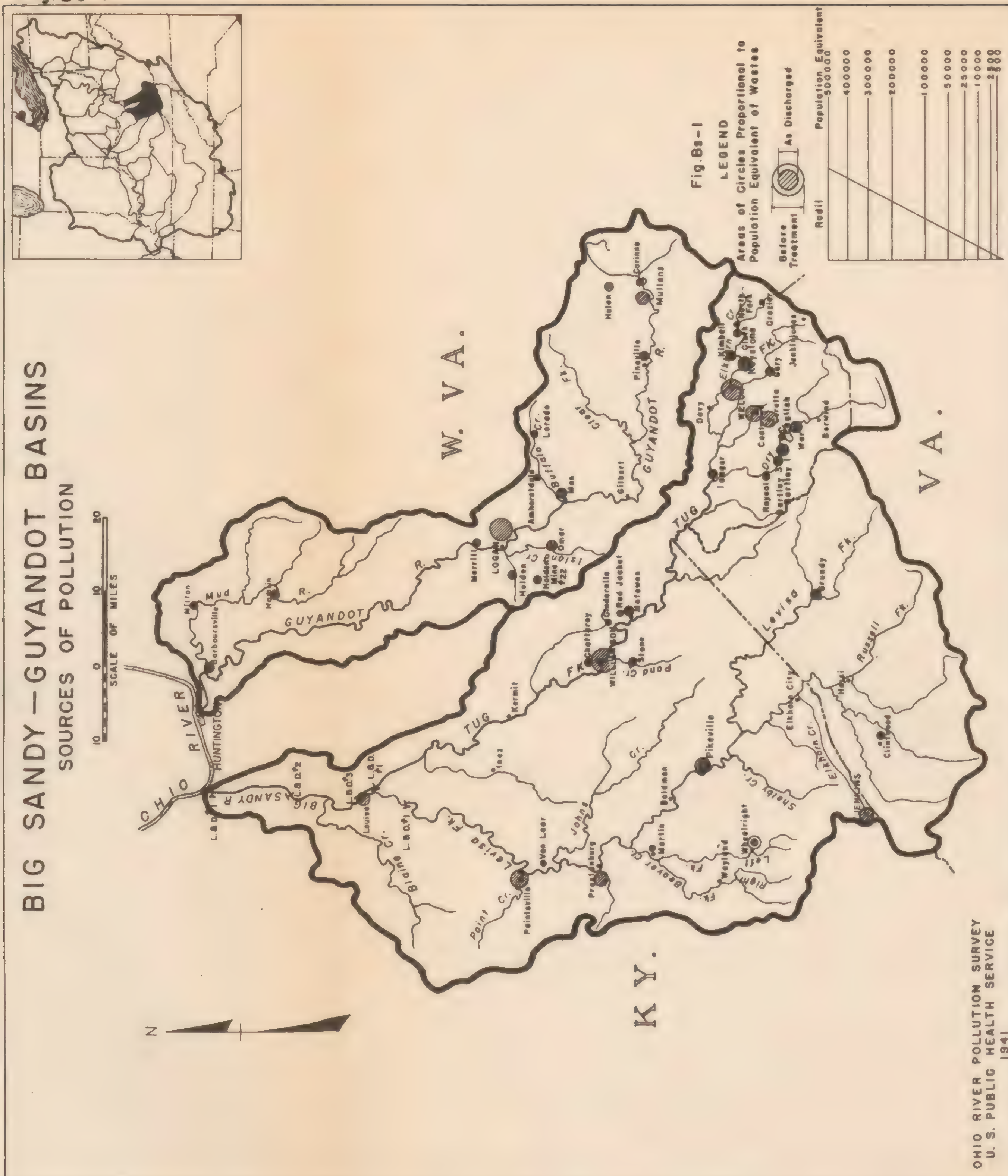
LIST OF TABLES

Bs–1.—Cost estimates of remedial measures	542
Bs–2.—Surface water supplies	544
Bs–3.—Sources of pollution	544
Bs–4.—Industrial wastes (omitted, not significant)	---
Bs–5.—Selected laboratory data	545
Bs–6.—Monthly mean summer flows	547
Bs–7.—Summary of laboratory data	550

LIST OF FIGURES

Bs–1. Map—Sources of pollution	541
Bs–2. Chart—Sources of pollution and selected laboratory data	544
Bs–3. Map—Coliform results	546
Bs–4. Map—Dissolved oxygen results	546
Bs–5. Map—Biochemical oxygen demand results	546

Fig. Bs-1



 GPO-43 0-90035

BIG SANDY RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Big Sandy Basin occupies 4,280 square miles in the mountainous section of eastern Kentucky, southern West Virginia, and western Virginia. Coal mining is the only important industry. Less than 8 percent of the 410,000 people in the area are in urban communities. Many of the people in rural areas live in mining camps and are served by water supplies. Poor sanitary conditions are found at many places. Sewage causes local nuisances and affects public water supplies. Acid mine drainage damages some small tributaries and coal washeries cause local blackening of several streams. Little progress has been made toward pollution control and there has been slight demand for stream improvement. Techniques are available for abatement of the pollution, but the needs of the people in other directions limit present justifiable corrections to the more acute situations affecting larger population groups.

CONCLUSIONS

(1) Fifteen surface water supplies are taken from streams below community sewer outfalls. Some of these supplies are seriously polluted by sewage from the community using the water.

(2) Only about 55,000 people are served by sewers and only 3 communities have sewage treatment facilities. Other than acid mine drainage and coal washery wastes there is no industrial pollution of consequence.

(3) Laboratory studies indicate that high coliform counts are a characteristic at most points. Dissolved oxygen is uniformly high and oxygen demand results were quite generally less than 3.0 parts per million. Acid conditions were found on two small tributaries but not on any of the larger streams. A greater pollution problem is indicated on Tug Fork than on Levisa Fork.

(4) Flow regulations by proposed flood-control reservoirs studied by the United States Engineer Department would have no appreciable effect on the pollution problem.

(5) The two main streams of the Big Sandy Basin, Levisa Fork and Tug Fork, are not heavily polluted. Primary treatment of wastes discharged to these streams should be sufficient to maintain good oxygen conditions at all points except below Grundy on upper Levisa Fork and Welch, W. Va., on Tug Fork.

(6) Local nuisance conditions are caused by the discharge of untreated sewage to a number of tributary streams. Secondary treatment will be required to prevent such nuisances. Considering the present financial condition of most of the towns, justification for the expenditures beyond partial treatment is questionable.

(7) The wastes from coal washeries can be removed by available methods, and the acid mine drainage load can be further reduced by mine sealing.

(8) In view of the normal uses of the streams involved, refined treatment at certain sources of pollution would serve no purpose commensurate with the expenditure. In these instances lesser treatment appears justified. A summary of cost estimates of remedial measures from table Bs–1 follows:

Treatment	Capital cost	Annual charges
Existing	$70,000	$10,000
Suggested additional	1,240,000	110,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are—

Treatment	Capital cost	Annual charges
Primary, all places	$1,190,000	$105,000
Secondary, all places	1,560,000	150,000

TABLE Bs–1.—*Big Sandy River Basin: Estimated cost of existing and suggested corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	0	3	2,600	$70,000	$6,000	$4,000	$10,000
Suggested minimum correction:							
Sewage treatment plants	20	2	43,600	740,000	50,000	35,000	85,000
Required interceptors				500,000	25,000		25,000
Independent industrial waste correction							
Total				1,240,000	75,000	35,000	110,000
Comparative cost:							
Primary treatment all waste				1,190,000	70,000	35,000	105,000
Secondary treatment all waste				1,560,000	100,000	50,000	150,000
As suggested				1,240,000	75,000	35,000	110,000

DESCRIPTION

The Big Sandy River, only 27 miles long, is formed by the confluence of Tug Fork and Levisa Fork and joins the Ohio River at Catlettsburg, Ky. It drains 4,280 square miles, of which 2,280 are in eastern Kentucky, 1,015 in western Virginia, and 985 in southern West Virginia. The area is mountainous and most of it is covered with second growth timber. Farming is largely of the subsistence type. Coal mining is the most important industry, and this basin includes a large part of the southern Appalachian coal field.

	Distance above mouth of Big Sandy	Drainage area (square miles)
Major tributaries:		
Blaine Creek	19.9	260
Tug Fork	27.2	1,550
Levisa Fork	27.2	2,330
Russell Fork	127.1	680

	Populations			
	1910	1920	1930	1940
Urban communities:				
Jenkins, Ky		4,707	8,465	9,428
Williamson, W. Va	3,561	6,819	9,410	8,366
Welch, W. Va	1,526	3,232	5,376	6,264
Pikeville, Ky	1,280	2,110	3,376	4,185
Keystone, W. Va	2,047	1,839	1,897	2,942
Entire basin:				
Rural	198,310	256,110	317,166	380,720
Urban	3,561	14,758	26,627	31,185
Total	201,871	270,868	343,793	411,905

Less than 8 percent of the population lives in urban communities. A large part of the rural population lives in villages and mining camps. The area drained by Tug Fork is the most densely populated part of the basin.

Water uses.—The Big Sandy throughout its length, the lower 12 miles of Tug Fork and the lower 18 miles of Levisa Fork, have been made navigable for boats of 6-foot draft by the construction of five locks and dams. The facilities are little used except near the mouth of the Big Sandy.

The streams are used extensively for recreation by local residents but there are no recreational developments in the area. Some consideration has been given to development of a public park in the scenic area along Russell Fork where it breaks through Pine Mountain at the Virginia-Kentucky border.

Presentation of Field Data

Figure Bs–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure Bs–2 shows similar data and, in addition, the location of water supply intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Of the 120 public water supplies in the basin 18 are wholly or in part from surface sources. These 18 serve 53,800 people, or about 40 percent of the population served by water supplies. Fifteen of the surface supplies come from streams subject to pollution. Table Bs-2 shows data on the surface water supplies. The underground water is limited in quantity and generally of poor quality, hard and often containing objectionable quantities of hydrogen sulfide. A number of the communities use mine drainage as a source of water.

TABLE Bs.–2—*Big Sandy River Basin Surface Water Supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
Catlettsburg	Kentucky	Big Sandy River	1.0	FD	10,100	0.50
Louisa	do	Levisa Fork	27.5	FD	1,600	.05
Paintsville	do	do	65.9	FD	4,000	.17
Prestonburg	do	do	82.5	FD	2,500	.09
Pikeville	do	do	115.7	FD	3,800	.33
Fort Gay	West Virginia	Tug Fork	27.3	FD	500	.02
Kermit	do	do	62.8	FD	800	.02
Borderland	do	do	78.4	FD	200	.01
Williamson	do	do	85.4	FD	10,000	.55
Matewan	do	do	98.4	FD	500	.03
Vulcan	do	do	107.0	LD	300	.05
Welch	do	Tug Fork, mine, wells	161.0	LD	6,500	.37
Berwind	do	Dry Fork, wells	164.5	LD	2,000	.36
Clinchco	Virginia	McClure River	153.0	FD	1,000	.03
Elkhorn City	Kentucky	Russell Fork	139.0	None	500	.03
	Other surface supplies					
Freeburn	Kentucky	Peters Creek, mine	106.0	FD	500	0.02
Jenkins	do	Impounded, spring, wells, mine		FD	8,500	.35
Pound	Virginia	Impounded		D	500	.01
Total:						
Below sewer outfalls					44,300	2.61
Other					9,500	.38
Total surface water supplies					53,800	2.99

[1] Miles above mouth of Big Sandy River.
[2] F=coagulated, settled, filtered; L=lime-soda softened; D=chlorinated.

Sewerage.—Table Bs–3 shows the sewered population at each of the more important sources of pollution in the basin. Of the 55,000 people connected to sewers, only 2,600 are connected to the three sewage-treatment plants in the basin. All of these plants provide secondary treatment.

TABLE Bs–3.—*Big Sandy River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	State	Receiving stream	Mile [1]	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Louisa	Kentucky	Levisa Fork, Big Sandy.	27	1,600	None	1,600	1,600
Prestonburg	do	do	82	1,900	do	1,900	1,900
Pikesville	do	do	114	2,900	do	2,900	2,900
Grundy	Virginia	do	168	1,100	do	1,100	1,100
Williamson	West Virginia	Tug Fork	84	8,000	do	8,000	8,000
Welch	do	Tug Fork, Elkhorn Creek.	160	5,900	do	5,900	5,900
Paintsville	Kentucky	Paint Creek	66	2,900	do	3,300	3,300
Wheelwright	do	Otter Creek	116	2,000	Secondary.	2,000	300
Jenkins	do	Elkhorn Creek	159	2,100	None	2,100	2,100
Bartley No. 1	West Virginia	Dry Fork	153	1,500	do	1,500	1,500
War	do	do	158	1,100	do	1,100	1,100

[1] Miles above mouth of Big Sandy River.

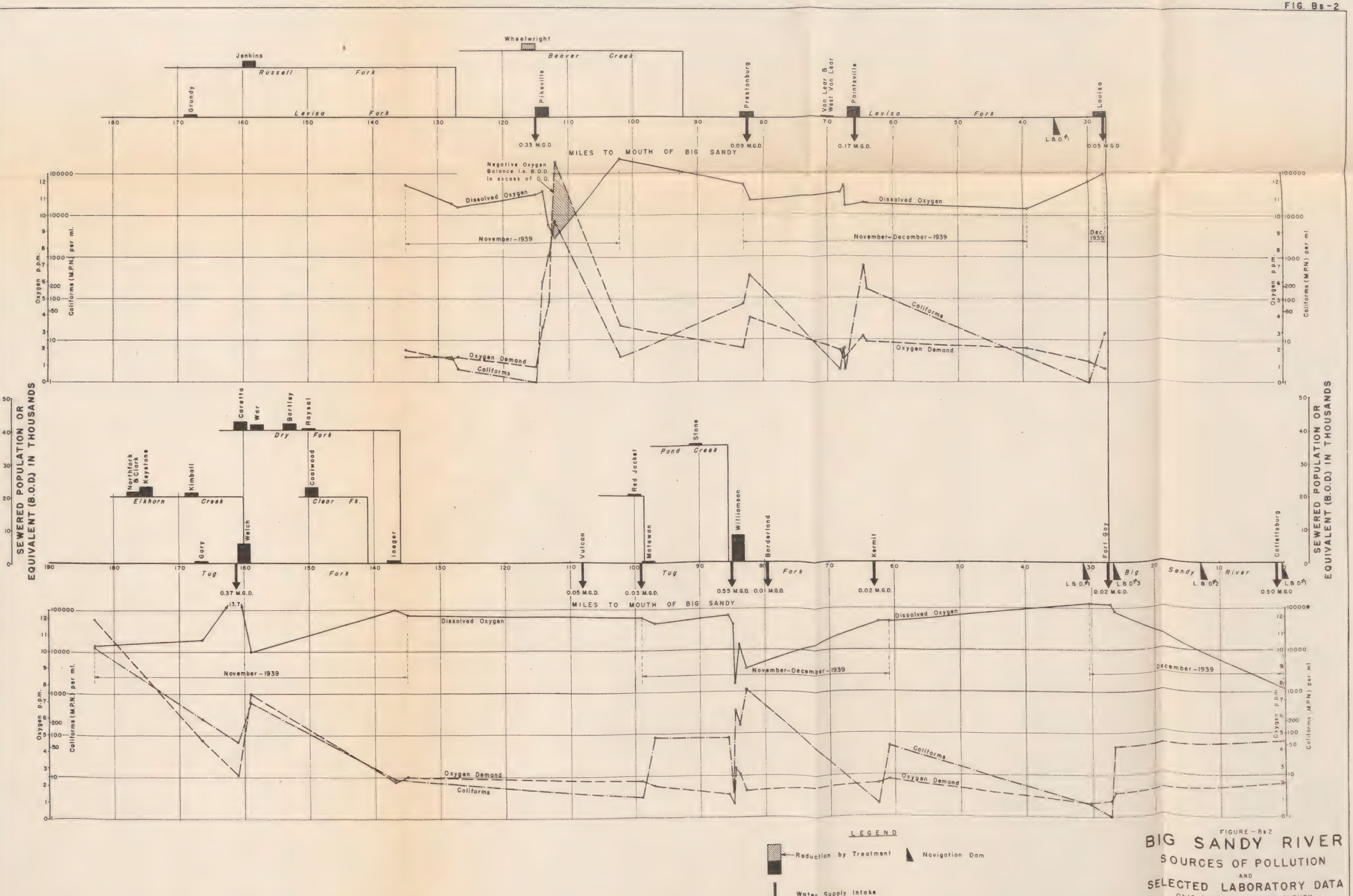


FIGURE - Bs 2
BIG SANDY RIVER
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1951

GPO-43 O-90035

TABLE Bs–3.—*Big Sandy River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*—Continued.

Municipality	State	Receiving stream	Mile	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Caretta	West Virginia	Barrenshe Creek	160	2,700	None	2,700	2,700
Coalwood	do	Clear Fork	149	3,000	do	3,000	3,000
Kimball	do	Elkhorn Creek	169	1,000	do	1,000	1,000
Keystone	do	do	175	2,900	do	2,900	2,900
54 smaller sources				14,400	(2)	14,400	14,400
Total:							
Virginia				2,600		2,600	2,300
Kentucky				15,900		16,300	14,600
West Virginia				36,500		36,500	36,400
Total				55,000		55,400	53,300

[2] 2 towns have septic tanks and subsurface filters. Other places, no treatment.

Industrial wastes.—The only plant in the basin discharging organic industrial wastes is a small meat-packing plant at Paintsville. In addition, there are 26 coal-washing plants which discharge varying amounts of fine coal particles. All but one of these are in the area drained by Tug Fork. Seventeen of the washeries recirculate wash water and recover the fines removed by washing. In almost every case black turbidity and deposits on the stream bottom were found below the plants.

PRESENTATION OF LABORATORY DATA

The laboratory data for the Big Sandy Basin are summarized in table Bs–7 (p. 550). Selected data on the main stream and on the tributaries are shown in table Bs–5.

TABLE Bs–5.—*Big Sandy River Basin: Selected laboratory data—Main stream and tributaries*

River	Big Sandy	Tug Fork	Tug Fork	Tug Fork	Levisa Fork	Levisa Fork	Levisa Fork
Location	Near Mouth	Above Williamson, W. Va.	Intake Williamson, W. Va.	Below Williamson, W. Va.	Above Pikesville, Ky.	Intake Pikesville, Ky.	Below Pikesville, Ky.
River miles above mouth of Big Sandy.	0.3	85.7	84.7	84	115	114	113
Number of samples	9	3	2	2	3	2	2
Flow in cubic feet per second:							
Sampling days	104	42	40	40	16	15	15
Water temperature °C	12.6	5.3	4.5	4.5	5.8	4.3	5.3
Coliforms per milliliter	54	81	350	142	1	242	6,700
Dissolved oxygen parts per million	6.1	12.1	8.0	10.3	11.2	11.4	8.6
Biochemical oxygen demand, 5-day, parts per million	2.1	1.4	2.9	2.6	0.9	3.3	13.2

TABLE Bs-5.—*Big Sandy River Basin: Selected laboratory data—Main stream and tributaries*—Continued

River	Tug Fork	Tug Fork	Elkhorn Creek	Paint Creek	Elkhorn Creek	Clear Creek	Dry Fork
Location	Above Welch, W. Va.	Below Welch, W. Va.	Below Jenkins, Ky.	Below Paintsville, Ky.	Below Kimball, W. Va.	Below Coalwood, W. Va.	Below War, W. Va.
River miles above mouth of Big Sandy.	161	159	158	66	168.6	149	157
Number of samples	3	3	3	4	3	2	3
Flow in cubic feet per second: Sampling days	9	9	(1)	2	3	(1)	7
Water temperature °C	6.0	4.0	6.3	4.4	2.0	6.3	7.3
Coliforms per milliliter	71	607	2,400	3,100	3,860	2,330	763
Dissolved oxygen parts per million	13.7	10.0	7.2	5.0	10.0	7.6	10.2
Biochemical oxygen demand, 5-day, parts per million	2.6	7.5	6.2	12.8	15.9	34.2	6.9

[1] Less than 1.

This basin was covered largely by a mobile laboratory unit operating during the period of October to December, 1939. Samples in the vicinity of Louisa and at the mouth were analyzed at the laboratory boat *Kiski* at Ashland during an 11-month period from June 1939 to April 1940. The stream flow during the period of operation of the mobile laboratory was low but both high and low discharges were observed during the sampling period covered by the *Kiski*.

Figures Bs-3, Bs-4, and Bs-5 show the location of the sampling points and the coliform, dissolved oxygen, and oxygen-demand observations. The results thus expressed represent the averages of from one to three individual samples where observations were made by a mobile laboraotry unit over short periods of less than 1 month at each sampling station and represent the most unfavorable monthly average where observations extended over several months.

Rather high coliform counts seem to be characteristic of the streams at most of the sampling points. Nearly half of all stations showed counts of more than 200 per milliliter and nearly 65 percent of all stations had counts of over 50 per milliliter. About half of the samples from above towns had coliform counts of over 50 per milliliter.

The dissolved oxygen was uniformly high, being above 6.5 parts per million except at six stations and the oxygen-demand results were quite generally less than 3.0 parts per million.

Acid stream conditions were observed in Muddy Creek, a tributary of Levisa Fork near Paintsville and along Mate Creek, a tributary of Tug Fork. pH values ranged from 3.9 to 4.8 and phenolphthalein acidities from 39 to 164 parts per million. None of the larger streams was found to be acid.

Except along Elkhorn Creek above Welch there was considreable evidence of self-purification taking place below sources of pollution. Laboratory determinations show marked reductions of coliform organisms and of oxygen demand in the stretches between sources of pollution. Coliform reductions are less marked during times of high discharge.

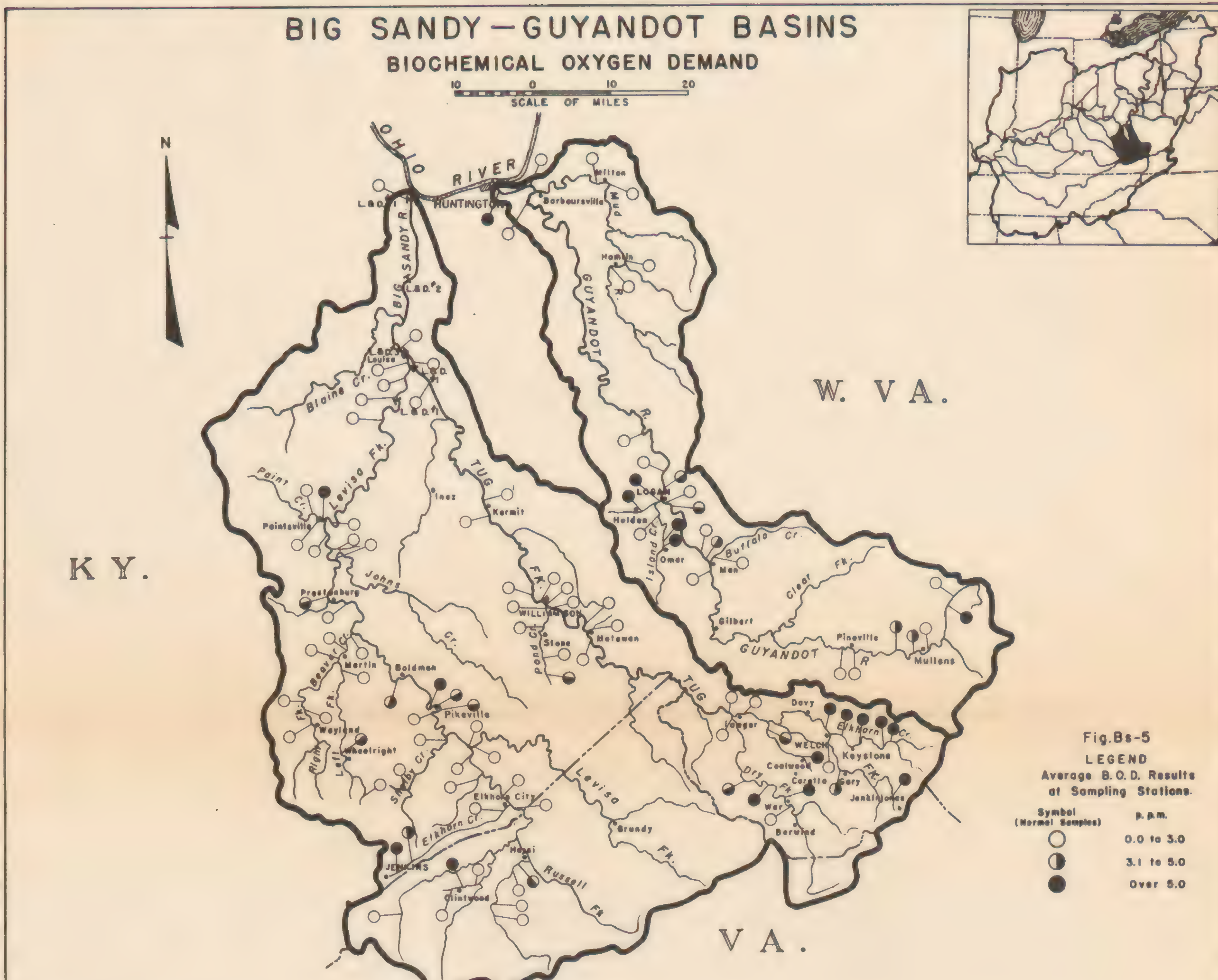
Laboratory data indicate a greater pollution problem on Tug Fork, particularly in the area above Iaeger, than on Levisa Fork. Self-purification forces appeared to bring about a reasonable clearance of

Fig. Bs-3

BIG SANDY — GUYANDOT BASINS
COLIFORM RESULTS
SCALE OF MILES
10 0 10 20
Fig. Bs-3
LEGEND
Average Coliform Results at Sampling Stations
Symbol
Most probable number per ml.
Under 25
26 - 50
51 - 100
101 - 200
Over 200
W. VA.
VA.
KY.
N
OHIO
RIVER
HUNTINGTON
BIG SANDY R.
GUYANDOT
TUG
Levisa
Mud
Milton
Barboursville
Hamlin
Logan
Pineville
Mullens
Welch
Williamson
Pikeville
Paintsville
Prestonsburg
Louisa
Kermit
Inez
Jenkins
Elkhorn City
Grundy
Russell Fk.
Johns Cr.
Paint Cr.
Blaine Cr.
Shelby Cr.
Beaver Cr.
Elkhorn Cr.
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Bs-4

BIG SANDY—GUYANDOT BASINS
DISSOLVED OXYGEN RESULTS


BIG SANDY—GUYANDOT BASINS
BIOCHEMICAL OXYGEN DEMAND
10 0 10 20
SCALE OF MILES
N
OHIO RIVER
HUNTINGTON
BIG SANDY R.
GUYANDOT R.
TUG FK.
Levisa Fk.
W. VA.
KY.
VA.
Milton
Barboursville
Mud
Hamlin
Logan
Holden
Island Cr.
Omar
Man
Buffalo Cr.
Clear Fk.
Gilbert
Pineville
Mullens
Kermit
Inez
Williamson
Stone
Matewan
Louisa
Blaine Cr.
Paint Cr.
Paintsville
Prestonsburg
Johns Cr.
Martin
Beaver Cr.
Boldman
Pikeville
Wayland
Wheelright
Shelby Cr.
Elkhorn City
Elkhorn Cr.
Jenkins
Clintwood
Haysi
Russell Fk.
Grundy
Davy
Welch
Keystone
Elkhorn Cr.
Coalwood
Caretta
Gary
Jenkinjones
War
Berwind
Dry Fk.
Fig. Bs-5
LEGEND
Average B. O. D. Results at Sampling Stations.
Symbol (Normal Samples)
p.p.m.
0.0 to 3.0
3.1 to 5.0
Over 5.0
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

the streams below sources of pollution during the time of this survey so that the acute pollutional problems in this basin tended to be largely local in their effects.

Biological summary.—Aquatic life is scarce in the Big Sandy for the entire length of the stream. The acid condition of some of the small headwater tributaries is detrimental to the aquatic life in these tributaries and portions of the main stream. Coal washeries have some local damaging effect on plankton. The average plankton volume is less than 1,000 parts per million. The small towns along the stream do not add sufficient sewage to fertilize the water and the rapid current is not suitable for the development of plankton. Fish are found at the mouth, probably having migrated from the Ohio, but the flesh is contaminated from industrial waste.

Hydrometric Data

Five stream-gaging stations are currently in operation in the Big Sandy Basin and two others have been discontinued. Table Bs–6 shows monthly mean flows during some of the driest periods.

TABLE Bs–6.—*Big Sandy River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Levisa Fork	Tug Fork
Location	Paints-Ky.	Kermit, W. Va.
River miles above mouth of Big Sandy	66	63
Drainage area (square miles)	2,150	1,185
Period of record	1929–40	1930–40
Year	1930	1930
June, cubic feet per second	137	114
July, do	26.5	44.5
August, do	145	78.7
September, do	33.2	29.4
Year	1932	1932
June, cubic feet per second	748	685
July, do	1,076	794
August, do	119	177
September, do	30.4	40.1
Year	1939	1939
June, cubic feet per second	1,010	612
July, do	1,540	1,090
August, do	345	280
September, do	54.7	60.6

Low-flow regulation.—There are no flood-control or hydroelectric reservoirs in the basin although a number of sites on Levisa Fork and its tributaries have been studied by the United States Engineer Department.

The locations of some of the possible reservoirs which might also be used for low-flow regulation are shown below:

Name	Stream	Miles above mouth of Big Sandy	Drainage area (square miles)
Fishtrap	Levisa Fork	130	395
Pound	Pound River	150	222
Haysi	Russell Fork	153	155
Wayland	Right Fork Beaver Creek	121	67
Dewey	Johns Creek	52	207

The Dewey and Fishtrap projects have been found to be most feasible. Under the proposed plan of operation the minimum seasonal flows could be increased by 2 cubic feet per second from Dewey and about 100 cubic feet per second from Fishtrap. This added flow would benefit stream reaches below the dam sites but is not sufficient to allow a reduction in the amount of treatment required. Hence, low-flow control originating at these projects would have little tangible value.]

Discussion

Because of the extensive use of Tug Fork and Levisa Fork as sources of water supply the need for sewage treatment to reduce bacterial pollution is greater than in many other parts of the Ohio Basin. A number of the water supplies, outstanding among which are Williamson and Pikeville, are subject to pollution from the town's own sewage.

The pollution-control problem is particularly difficult because of the many mining camps which are only partly sewered and for which the provision of interceptors and treatment plants would be quite expensive. The lack of other community facilities, the high indebtedness, and the lack of permanence of many of the communities are factors to be considered. Although there is ample apparent justification for an adequate pollution-control program, the difficulty of financing remedial works necessitates careful examination of the relative benefits and costs of each project.

At the communities along Levisa Fork below Russell Fork primary treatment of all sewage should be sufficient to maintain excellent dissolved oxygen conditions in the stream. This applies also to Paintsville which would, presumably, intercept the wastes now discharged to Paint Creek and discharge them, after treatment, to Levisa Fork. At Williamson and at the smaller communities along Tug Fork below Welch primary treatment should be sufficient.

At Grundy on upper Levisa Fork and at Welch on Tug Fork at the confluence of Elkhorn Creek, as well as at the numerous towns on tributaries of the two main streams, secondary treatment will be necessary if nuisance conditions are to be eliminated during the dry summer months. The receiving streams at all of these places are subject to flows approaching zero. At the two larger communities, Grundy and Welch, the problem involves a larger population and is more acute. As a logical starting point, installation of secondary treatment is suggested at these two points. As far as the balance of the pollution is concerned, it is suggested that a partial treatment be installed at all places where as many as 500 people are discharging sewage. Such treatment should do much toward reducing the effects of the sewage on downstream water intakes. Secondary treatment facilities can be added at these places as community finances permit.

The practice of disposing of garbage and other refuse by dumping it along the stream banks or into the streams is common in this area. Unless this practice is changed, even the provision of sewage treatment will not maintain the streams in good condition. There are also many privies built over the streams or along stream banks where their contents can easily enter the streams. Much progress has been made with Work Projects Administration assistance in building sanitary privies, but the program is not complete.

The elimination of pollution by coal-washery wastes presents no particular technical problems. Methods now in use in other places permit the recovery of virtually all of the fine material now entering the streams. At the time a demand develops for control of this largely visual pollution, proper corrective measures should be taken.

Acid mine drainage does not affect any of the larger streams. Completion of the program of sealing abandoned mines will help to improve conditions in those tributaries which are still acid.

Flow regulation by the proposed flood-control reservoirs would have no appreciable effect on the need for the suggested pollution-abatement program. The estimated cost of the suggested pollution-abatement works for the Big Sandy Basin has already been presented in table Bs–1.

TABLE Bs-7.—*Big Sandy River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Tug Fork, below Jenkinjones, W. Va.	BsT 183	Nov. 9, 1939		7.0	10.3	84.4	13.8	2,400	7.6	140	101	1,062
Do	do	Nov. 14, 1939		4.5	10.5	80.9	10.2	21,000	7.8	32	118	
Tug Fork, below Gary, W. Va.	BsT 166.5	Nov. 9, 1939		9.0	11.3	97.2	5.7	240	7.6	5	139	1,080
Do	do	Nov. 14, 1939		5.0	10.1	78.5	3.7	240	7.7	3	121	
Tug Fork, above Welch, W. Va.	BsT 161	Nov. 9, 1939		9.0	14.8	127.5	2.6	9	7.5	5	163	494
Do	do	Nov. 14, 1939		7.0	14.5	119.2	2.2	110	8.4	7	177	
Do	do	Nov. 17, 1939		2.0	11.9	86.2	3.1	93	7.9	8	201	
Elkhorn Creek, below North Fork, W. Va.	BsTE 176.5	Nov. 9, 1939		1.5	11.8	84.0	11.0	2,400	8.3	65	306	1,020
Do	do	Nov. 14, 1939		1.5	11.7	83.3	13.7	7,500	8.3	105	291	
Do	do	Nov. 17, 1939		1.0	12.4	86.9	8.8	4,300	8.2	65	302	
Elkhorn Creek, below Keystone, W. Va.	BsTE 175	Nov. 9, 1939		1.5	10.3	73.3	13.9	2,400	8.4	260	291	910
Do	do	Nov. 14, 1939		1.5	10.9	77.5	14.3	3,600	8.3	280	287	
Do	do	Nov. 17, 1939		3.0	9.3	68.9	14.1	2,400	8.4	35	325	
Elkhorn Creek, below Kimball, W. Va.	BsTE 168.6	Nov. 9, 1939		2.0	9.8	70.4	10.0	2,400	8.6	500	301	894
Do	do	Nov. 14, 1939		1.5	10.0	71.3	11.9	4,600	8.4	430	317	
Do	do	Nov. 17, 1939		2.5	10.4	76.1	9.9	4,600	8.4	185	326	
Elkhorn Creek, above Welch, W. Va.	BsTE 161	Nov. 9, 1939		2.5	11.4	83.6	5.1	240	8.1	93	295	818
Do	do	Nov. 14, 1939		3.0	11.5	85.4	6.3	430	8.4	120	307	
Do	do	Nov. 17, 1939		2.5	11.7	85.4	5.6	390	8.3	91	225	
Tug Fork, below Welch, W. Va.	BsT 159	Nov. 9, 1939			8.8		11.4	460	8.1	18	275	1,020
Do	do	Nov. 14, 1939		5.5	10.8	85.0	4.8	930	8.1	28	337	
Do	do	Nov. 17, 1939		2.5	10.5	76.7	6.2	430	8.1	63	279	
Clear Fork, below Coalwood, W. Va.	BsTCf 149	Nov. 10, 1939		5.0	2.5	19.7	63.0	4,300	7.2	38	275	395
Do	do	Nov. 15, 1939		7.5	12.6	104.6	5.3	360	7.3		25	177
Clear Fork, at mouth	BsTCf 141	do		1.0	11.4	79.8	4.8	(1)	7.5	12	140	
Do	do	Nov. 20, 1939		9.5	10.3	90.1	3.2	(1)	7.5	12	133	
Tug Fork, above Iaeger, W. Va.	BsT 137	Nov. 10, 1939		9.5	13.0	113.1	1.8	21	8.4	3	240	235
Do	do	Nov. 15, 1939		1.0	12.6	88.8	2.3	2	8.3	3	284	
Do	do	Nov. 20, 1939		7.5	11.9	98.7	2.5	4	8.4	7	245	
Dry Fork, above War, W. Va.	BsTDf 159	Nov. 10, 1939		5.0	12.3	96.2	1.4	43	7.6		127	195
Do	do	Nov. 15, 1939		6.0	12.5	99.8	1.2	4	8.2	7	165	
Do	do	Nov. 20, 1939		8.5	10.1	85.8	2.2	9	8.0	3	134	
Dry Fork, below War, W. Va.	BsTDf 157	Nov. 10, 1939			11.5		4.2	930	7.6	7	138	295
Do	do	Nov. 15, 1939		5.0	10.7	83.8	5.4	430	7.6	2	152	
Do	do	Nov. 20, 1939		9.5	8.4	73.6	11.1	930	7.7	3	152	

Dry Fork, above Bartley, W. Va.	BsTDf 154	Nov. 10, 1939	----------	6.5	12.8	103.9	4.0	93	8.1	5	211	215
Do	do	Nov. 15, 1939	----------	2.0	10.1	72.7	6.6	460	7.9	18	236	----------
Do	do	Nov. 20, 1939	----------	9.0	11.2	96.2	5.8	460	7.9	----------	220	----------
Dry Fork below Rayseal, W. Va.	BsTDf 150	Nov. 10, 1939	----------	8.0	11.6	97.7	3.6	2,400	8.4	115	246	185
Do	do	Nov. 15, 1939	----------	2.0	10.7	77.5	6.3	1,500	8.1	7	281	----------
Do	do	Nov. 20, 1939	----------	10.5	8.1	72.3	4.9	2,300	8.2	215	245	----------
Dry Fork, above Iaeger, W. Va.	BsTDf 137	Nov. 10, 1939	----------	8.0	12.4	104.4	2.0	4	8.3	----------	214	315
Do	do	Nov. 15, 1939	----------	2.0	12.5	90.5	1.9	1	8.3	2	229	----------
Tug Fork, below Iaeger, W. Va.	BsT 135	Nov. 10, 1939	----------	10.0	12.9	114.1	1.7	36	8.4	10	235	245
Do	do	Nov. 15, 1939	----------	2.0	12.2	88.4	2.7	110	8.4	----------	244	----------
Do	do	Nov. 20, 1939	----------	8.0	11.4	96.2	3.2	1,100	8.4	5	247	----------
Tug Fork, above Matewan, W. Va.	BsT 99	Nov. 24, 1939	----------	6.5	11.5	93.7	2.0	4	7.7	5	222	170
Do	do	Nov. 29, 1939	----------	3.0	12.4	92.1	2.4	1	7.6	2	198	----------
Mate Creek, above Matewan, W. Va.	BsTM 99	Nov. 24, 1939	----------	7.0	12.1	99.5	1.6	1	3.9	----------	----------	830
Mate Creek, at mouth	BsTM 98.5	do	----------	6.5	12.4	100.3	1.9	4	4.0	8	----------	780
Do	do	Nov. 29, 1939	----------	1.0	14.0	98.2	2.0	2	4.1	----------	----------	----------
Do	do	Dec. 4, 1939	----------	3.5	11.6	87.3	2.0	1	4.0	2	----------	----------
Tug Fork, below Matewan, W. Va.	BsT 97	Nov. 24, 1939	----------	6.5	11.3	91.6	2.4	230	7.5	7	173	190
Do	do	Nov. 29, 1939	----------	2.5	12.4	90.6	2.3	7	7.5	8	188	----------
Do	do	Dec. 4, 1939	----------	3.0	11.5	85.5	1.0	9	7.5	5	192	----------
Pond Creek, ½ mile below McVeigh, Ky.	BsTP 95.5	Nov. 8, 1939	----------	8.5	8.6	73.5	8.3	2,400	7.6	51	196	----------
Do	do	Nov. 15, 1939	----------	2.0	11.8	85.1	1.6	2,400	7.8	6	246	----------
Pond Creek below mouth of Pinson Fork, McAndrew, Ky.	BsTP 93.5	Nov. 8, 1939	----------	9.0	12.1	104.0	3.5	1,100	7.8	9	226	----------
Do	do	Nov. 15, 1939	----------	1.5	12.7	90.3	1.7	43	7.8	4	247	230
Pond Creek, 1 mile below Stone, Ky.	BsTP 89.5	Nov. 8, 1939	----------	10.0	11.5	101.3	1.7	93	8.0	6	219	----------
Do	do	Nov. 15, 1939	----------	2.0	13.1	94.4	2.0	43	7.9	5	225	181
Pond Creek, 100 yards above mouth, Williamson, W. Va.	BsTP 85.3	Nov. 8, 1939	----------	7.5	10.5	87.5	1.9	460	7.4	15	185	----------
Pond Creek at mouth	do	Nov. 29, 1939	----------	2.0	13.0	93.7	2.9	460	7.4	25	204	160
Do	do	Dec. 4, 1939	----------	4.0	11.6	88.3	1.5	4	7.6	12	204	----------
Tug Fork, above Williamson, W. Va.	BsT 85.7	Nov. 29, 1939	----------	3.5	12.7	95.2	2.1	(1)	7.8	3	178	180
Do	do	Dec. 4, 1939	----------	4.5	11.6	89.5	.8	240	7.9	3	190	----------
Do	do	Dec. 6, 1939	----------	8.0	11.9	100.3	1.4	4	7.6	2	182	----------
Tug Fork, upper edge of Williamson, W. Va.	BsT 85.0	Nov. 8, 1939	----------	7.0	11.6	95.0	.8	4	7.8	5	176	----------
Tug Fork, waterworks intake, Williamson, W. Va.	BsT 84.7	Nov. 29, 1939	----------	4.0	3.6	27.6	3.4	240	8.4	7	188	190
Do	do	Dec. 4, 1939	----------	5.0	12.4	96.6	2.4	460	8.1	5	191	----------
Tug Fork below Williamson, W. Va.	BsT 84	Nov. 29, 1939	----------	4.5	11.5	88.7	3.6	43	7.6	3	188	180
Do	do	Dec. 4, 1939	----------	4.5	9.1	69.9	1.6	240	7.6	2	182	----------
Tug Fork, 1 mile below sewage, Williamson, W. Va.	BsT 83	Nov. 8, 1939	----------	8.0	8.9	75.3	1.6	1,100	7.7	5	179	----------
Tug Fork, above Kermit, W. Va.	BsT 63	Nov. 24, 1939	----------	6.0	10.8	86.6	2.5	2	7.8	5	153	230
Do	do	Nov. 29, 1939	----------	4.5	12.6	97.1	2.5	2	7.6	5	158	----------
Do	do	Dec. 4, 1939	----------	4.5	11.7	90.0	1.1	2	7.6	5	159	----------
Tug Fork, below Kermit, W. Va.	BsT 61	Nov. 24, 1939	----------	6.5	10.8	87.4	2.3	36	7.6	5	154	220
Do	do	Nov. 29, 1939	----------	5.0	12.8	99.8	2.7	4	7.6	3	146	----------
Do	do	Dec. 4, 1939	----------	4.0	11.6	88.3	1.6	110	7.5	----------	152	----------

[1] Less than 1.

TABLE Bs-7.—*Big Sandy River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Tug Fork, station 3.8 dam No. 1	BsT 30.3	June 23, 1939		27.0	6.6	81.8	2.1	75		900	34	
Do	do	Aug. 4, 1939		27.0	7.4	91.7	.6	24				
Do	do	Aug. 18, 1939		26.0	7.1	86.4	1.5	75				
Do	do	Sept. 1, 1939		24.0	7.2	84.6	.8	23	7.8	5	78	
Do	do	Sept. 15, 1939		24.5	7.0	82.6	.7	4				
Do	do	Sept. 29, 1939		23.0	7.7	88.6	.6	4				
Do	do	Oct. 13, 1939		14.0	9.1	87.6	1.0	4				
Do	do	Oct. 27, 1939		20.0	7.7	84.0	.9	1				
Do	do	Nov. 10, 1939		6.0	11.4	91.4	.5	(1)				
Do	do	Nov. 24, 1939		7.0	11.4	93.8	1.0					
Do	do	Dec. 8, 1939		4.5	12.0	92.4	.6	1				
Do	do	Dec. 29, 1939		1.5	13.6	97.0	.9	2				
Do	do	Feb. 9, 1940		2.5	13.2	97.0	.6	2				
Do	do	Feb. 13, 1940		6.5	11.4	92.6	1.4	21				
Do	do	Mar. 8, 1940		4.5	12.0	92.4	.5	93				
Do	do	Apr. 5, 1940		14.0	9.2	88.7	.8	240				
Tug Fork, station 0.1, Fort Gay, W. Va.	BsT 27.2	July 7, 1939		25.0	6.8	81.1	1.2	1,100	7.3	260	26	
Do	do	July 21, 1939		22.5	7.4	84.2	1.4	240	7.2	350	28	
Do	do	Aug. 4, 1939		25.5	7.3	87.7	.6	46	7.5	85	42	
Do	do	Aug. 18, 1939		26.0	6.5	79.6	1.5	43	7.5	220	64	
Do	do	Sept. 1, 1939		25.0	8.0	96.1	1.4	23				
Do	do	Sept. 15, 1939		25.0	7.5	89.5	.6	4	7.9	7	85	
Do	do	Sept. 29, 1939		23.5	8.2	95.5	.7	(1)	8.0	3	114	
Do	do	Oct. 13, 1939		19.0	8.4	89.3	.9	4	8.0	8	121	
Do	do	Oct. 27, 1939		18.0	8.6	89.9	.8		7.8	12	110	
Do	do	Nov. 10, 1939		7.5	9.9	82.1	1.1	21	7.7	17	89	
Do	do	Nov. 24, 1939		7.5	10.1	84.1	1.0	4	7.6	7	113	
Do	do	Dec. 8, 1939		4.5	12.2	93.7	.5	1	7.4	7	135	
Do	do	Dec. 29, 1939		2.0	13.3	96.0	1.2	2	7.4	7	76	
Do	do	Feb. 9, 1940		2.0	13.1	94.8	.9	(1)	6.8	21	66	
Do	do	Feb. 13, 1940		6.5	11.3	92.0	2.0		7.6	110	53	
Do	do	Mar. 8, 1940		4.5	12.0	92.4	.5	23	6.8	37	26	
Do	do	Apr. 5, 1940		13.0	9.2	86.7	.9	93	6.5	95	30	
Levisa Fork, at bridge, Nigh, Ky	BsL 135	Nov. 14, 1939		7.5	11.8	98.3	1.9	4	7.2	8	43	112
Levisa Fork, above Russell Fork	BsL 128.1	Nov. 6, 1939		5.5	10.7	84.9	1.4	4	7.2	30	39	
Levisa Fork, at mouth of Russell Fork.	BsL 127.1	Nov. 13, 1939		6.0	10.5	84.5	1.5	2	7.0	15	39	
McClure River, 100 yards above Fremont, Va.	BsLRMc 160	Nov. 10, 1939		8.5	10.0	85.6	1.2	23	7.8	8	188	141

McClure River, below Fremont, Va.	BsLRMc 159	Nov. 7, 1939		6.0	11.9	95.7	1.3	150	8.0	12	207	
McClure River, waterworks intake, Clincho, Va.	BsLRMc 153	do		5.5	11.2	88.5	1.1	93	7.8	10	208	
Do	do	Nov. 10, 1939		8.0	10.9	91.8	1.1	150	7.9	7	207	180
McClure River, lower edge of Clincho, Va.	BsLRMc 152	Nov. 7, 1939		5.5	8.6	67.8	4.0	2, 400	7.7	18	190	
Do	do	Nov. 10, 1939		8.0	8.1	68.0	5.4	430	7.7	5	198	203
Do	do	Nov. 16, 1939		4.5	9.0	69.0	5.2	430	7.7	13	178	
Holly Creek, lower edge of Clintwood, Va.	BsLRPCH 162	Nov. 7, 1939		10.5	0	0	130	240, 000	7.2	190	424	
Do	do	Nov. 10, 1939		10.0	0	0	150	1, 100, 000	7.4	155	462	172
Do	do	Nov. 16, 1939		9.0	1.4	12.5	168	2, 400	7.4	550	255	
Holly Creek, 3 miles below Clintwood, Va.	BsLRPCH 159	do		1.5	12.0	85.9	.7	4	7.1	8	58	
Pound River, ¾ mile below Pound, Va.	BsLRP 171.3	Nov. 7, 1939		8.0	8.7	73.0	3.5	43	6.9	65	69	
Do	do	Nov. 10, 1939		6.0	7.3	58.3	2.2	240	6.8	27	62	132
Russell Fork, above Elkhorn City, Ky.	BsLR 140	Nov. 6, 1939		5.5	12.1	95.5	1.0	4	7.6	12	92	
Do	do	Nov. 13, 1939		5.0	11.4	89.5	1.4	1	7.6	10	99	127
Elkhorn Creek, 1 mile below Jenkins, Ky.	BsLRE 158	Nov. 7, 1939		10.0	7.3	64.5	6.7	2, 400	7.8	13	296	
Do	do	Nov. 10, 1939		6.5	6.6	53.2	5.4	2, 400	7.7	7	307	
Do	do	Nov. 16, 1939		2.5	7.6	56.0	6.7	2, 400	7.6	10	269	
Elkhorn Creek, 3 miles below Jenkins, Ky.	BsLRE 156	Nov. 7, 1939		9.5	17.6	153.8	3.7	240	8.5	5	258	
Do	do	Nov. 10, 1939		5.5	9.8	77.8	3.2	93	7.8	5	264	284
Elkhorn Creek, at mouth above Elkhorn City, Ky.	BsLRE 140	Nov. 6, 1939		2.5	13.6	99.6	.8	23	7.9	6	138	
Do	do	Nov. 13, 1939		4.0	13.1	99.4	.8	4	7.9	5	139	204
Russell Fork, below Elkhorn City, Ky.	BsLR 138	Nov. 6, 1939		6.0	11.9	95.6	2.2	43	7.7	8	103	
Do	do	Nov. 13, 1939		7.0	11.1	91.4	2.4	93	7.6	8	108	
Marrowbone Creek, at mouth Marrowbone, Ky.	BsLRM 134	do		3.0	12.0	88.9	.8	7	7.2	4	67	166
Russell Fork, above Millard, Ky.	BsLR 128	Nov. 6, 1939		6.0	11.3	90.6	1.0	4	7.5	18	78	
Do	do	Nov. 13, 1939		6.0	10.9	87.5	1.4	1	7.4	12	83	126
Long Fork, 200 yards above mouth, Virgie, Ky.	BsLSL 132	Nov. 9, 1939		2.0	12.3	89.2	.6	210	7.1	4	41	
Do	do	Nov. 14, 1939		1.5	12.5	88.9	.7	91	7.0	4	42	82
Shelby Creek, at mouth Shelbiana, Ky.	BsLSL 121	Nov. 6, 1939		3.5	12.3	92.3	.6	4	7.4	48		15
Do	do	Nov. 13, 1939		4.5	11.4	87.6	1.8	2	7.2	4	47	171
Levisa Fork, ½ mile above Pikeville, Ky.	BsL 115	Nov. 9, 1939		5.0	11.3	88.0	.6	4	7.3	18	63	
Do	do	Nov. 14, 1939		8.5	11.3	96.6	1.0	(1)	7.4	24	68	131
Do	do	Nov. 15, 1939		4.0	11.1	84.7	1.2	1	7.3	8	67	134
Levisa Fork, waterworks intake, Pikeville, Ky.	BsL 114	Nov. 14, 1939		4.0	11.2	85.6	4.0	23	7.3	15	66	123
Do	do	Nov. 15, 1939		4.5	11.5	88.6	2.6	460	7.3	18	69	

[1] Less than 1.

TABLE Bs-7.—*Big Sandy River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Levisa Fork, lower edge of Pikeville, Ky.	BsL 113	Nov. 9, 1939		8.0	8.6	72.6	3.6	1,100	7.2	12	65	
Do	do	Nov. 14, 1939		10.5	10.8	96.1	6.3	930	7.3	20	74	140
Do	do	Nov. 15, 1939		7.0	8.9	72.9	4.5	1,100	7.2	20	75	140
Levisa Fork, 100 feet below main sewer, Pikeville, Ky.	do	Nov. 14, 1939		4.5	8.0	62.0	10.5	2,400	7.1	20	75	153
Do	do	Nov. 15, 1939		6.0	9.3	74.2	16.0	11,000	7.1	35	89	161
Levisa Fork, under bridge below Boldman, Ky.	BsL 102	Nov. 9, 1939	19	12.0	13.4	123.8	3.4	4	7.9	16	67	
Left Fork Beaver Creek, lower edge of Weeksbury, Ky.	BsLBLf 102.5	do		2.5	13.9	102.0	.7	9	8.0	6	288	
Do	do	Nov. 14, 1939		2.5	14.3	104.8	1.9	110	8.2	4	268	183
Left Fork Beaver Creek, lower edge Wheelwright, Ky.	BsLBLf 116	Nov. 9, 1939		3.0	11.8	87.3	4.5	93	7.7	14	191	
Do	do	Nov. 14, 1939		3.5	11.3	84.7	5.7	240	7.8	25	202	467
Left Fork Beaver Creek, 100 yards above mouth.	BsLBLf 96.5	Oct. 30, 1939		10.5	10.6	94.5	.7	460	7.5	28	78	
Do	do	Nov. 1, 1939		8.5	11.1	95.0	.5	9	7.4	5	94	
Right Fork Beaver Creek, lower edge Wayland, Ky.	BsLBRf 113	Oct. 30, 1939		9.5	9.8	85.2	1.5	460	7.1	47	52	
Do	do	Nov. 1, 1939		7.5	9.4	78.2	3.0	2,400	7.3	500	51	
Right Fork Beaver Creek, ¼ mile above Garrett, Ky.	BsLBRf 110.7	Oct. 30, 1939		8.5	9.7	82.6	.8	43	7.2	35	37	
Do	do	Nov. 1, 1939		7.5	10.4	86.8	.3	93	7.3	32	56	
Right Fork Beaver Creek, lower edge of Garrett, Ky.	BsLBRf 110	Oct. 30, 1939		9.0	9.6	82.5	2.0	1,100	7.3	36	54	
Do	do	Nov. 1, 1939		8.0	9.9	83.7	1.9	460	7.3	40	87	
Beaver Creek, ¼ mile above Martin, Ky.	BsLB 96.8	Oct. 30, 1939		12.0	8.4	77.7	2.2	43	7.4	24	77	
Do	do	Nov. 1, 1939		10.0	8.8	77.4	.9	23	7.3	18	69	
Beaver Creek, lower edge of Martin, Ky.	BsLB 96	Oct. 30, 1939		11.5	8.2	75.0	2.8	150	7.7	15	114	
Do	do	Nov. 1, 1939		9.5	8.5	74.3	2.5	1,100	7.3	22	81	
Beaver Creek, at mouth Allen, Ky	BsLB 92.2	Oct. 30, 1939		11.5	9.0	82.4	1.3	240	7.7	14	160	
Do	do	Nov. 1, 1939		11.0	9.4	85.1	1.7	240	7.4	17	95	
Levisa Fork, water plant, Prestonsburg, Ky.	BsL 83	Nov. 21, 1939		8.5	11.0	94.1		240	7.1	14	87	
Do	do	Nov. 24, 1939		7.0	10.8	88.7	1.6	4	7.2	17	88	
Do	do	Nov. 28, 1939		5.0	12.4	97.0	2.3	4	7.4	15	86	
Do	do	Dec 1, 1939		5.5	12.8	101.0	2.0	43	7.2	19	80	

Levisa Fork, below all sewage, Prestonbury, Ky.	BsL 82	Nov. 21, 1939		8.5	10.5	89.2		1,100	7.0	17	88	156
Do	do	Nov. 24, 1939		7.0	10.6	87.2	1.6	150	7.1	20	86	
Do	do	Nov. 28, 1939		3.0	12.6	93.3	2.2	23	7.3	12	84	
Do	do	Dec. 1, 1939		6.0	9.9	79.0	7.7	93	7.0	27	91	
John Creek, at mouth, Auxier, Ky	BsLJ 74	Nov. 21, 1939		8.0	10.2	85.8			7.2	7	189	143
Do	do	Nov. 24, 1939		6.0	11.3	90.5	.8	23	7.4	14	127	
Do	do	Nov. 28, 1939		.5	13.3	92.1	.9	2	7.4	5	101	
Do	do	Nov. 29, 1939		2.0				4				
Miller Creek, at mouth, Van Lear, Ky.	BsLM 68.9	Nov. 21, 1939		8.0	9.5	79.9		15	7.4	13	121	
Do	do	Nov. 24, 1939		6.0	10.6	84.9	.3	24	7.7	11	218	
Do	do	Nov. 28, 1939		.5	12.7	87.8	1.0	4	7.7	13	202	
Levisa Fork, 1½ miles below Van Lear, Ky.	BsL 68	Nov. 22, 1939		7.0	10.5	86.4	2.0	4	7.3	12	87	
Do	do	Nov. 29, 1939		3.5	12.0	90.3	1.9	(1)	7.3	11	89	
Levisa Fork, above Paintsville, Ky	BsL 67.5	Nov. 28, 1939		4.0	11.3	86.3	1.3	8	7.4	7	84	
Do	do	Nov. 30, 1939		4.0	11.9	90.3	1.1	9	7.3	8	85	
Do	do	Dec. 1, 1939		6.0	12.0	96.1	1.8	2	7.3	7	85	
Levisa Fork, above water plant, Paintsville, Ky.	BsL 67.2	Nov. 21, 1939		8.5	10.6	90.7		2	7.2	8	89	153
Do	do	Nov. 22, 1939		7.5	10.4	86.6	2.0	2	7.3	8	86	
Paint Creek, above Paintsville, Ky	BsLP 67.5	Nov. 29, 1939		4.0	10.7	81.5	1.2	46	7.1	17	90	
Paint Creek, upper edge of Paintsville, Ky.	BsLP 67	Nov. 20, 1939		9.0	9.3	80.2		4	7.2	25	99	202
Do	do	Nov. 24, 1939		6.0	8.0	63.9	1.1	4	7.0	25	93	
Do	do	Nov. 27, 1939		5.5	10.0	78.7	.8	9	7.2	20	83	
Do	do	Dec. 1, 1939		5.0	10.7	83.7	.8	4	7.1	22	86	
Paint Creek, 100 yards above mouth, Paintsville, Ky.	BsLP 66.5	Nov. 20, 1939		9.0	2.3	20.1		4,600	7.0	37	102	254
Paint Creek, at mouth, Paintsville, Ky.	BsLP 66	Nov. 24, 1939		7.0	1.7	14.3	10.9	2,300	7.0	30	104	
Do	do	Nov. 27, 1939		5.0	5.2	40.3	7.8	4,600	7.0	25	103	
Do	do	Nov. 29, 1939		1.0	6.7	47.4	15.7	4,600	7.1	21	101	
Do	do	Dec. 1, 1939		4.5	6.6	50.7	17.0	930	7.0	32	99	
Muddy Branch, at mouth, Paintsville, Ky.	BsLM 65	Nov. 22, 1939		7.0	11.0	90.1	1.6	1	4.8	7		154
Do	do	Nov. 29, 1939		.5	13.2	91.3	2.0	2	4.8	6		
Do	do	Nov. 30, 1939		5.0	11.6	90.5	1.2	2	4.8	6		
Levisa Fork, below mouth, Paint Creek, Paintsville, Ky.	BsL 64.5	Nov. 21, 1939		8.5	10.1	86.1		460	7.2	13	89	158
Do	do	Nov. 28, 1939		4.0	11.0	83.7	1.7	240	7.3	12	86	
Do	do	Dec. 1, 1939		5.5	11.1	87.9	3.7	1,100	7.3	18	87	
Levisa Fork, below Paintsville, Ky	BsL 64	Nov. 22, 1939		8.0	9.8	82.5	2.2	93	7.2	10	87	
Do	do	Nov. 30, 1939		4.5	11.5	88.8	2.6	240	7.3	13	89	
Shannon Branch, 2 miles below mouth Georges Creek.	BsLS 40	Nov. 29, 1939		2.5	12.9	94.5	1.3	(1)	7.3	8	90	
Levisa Fork, 2½ miles below Georges Creek.	BsL 39.5	Nov. 22, 1939		7.5	10.4	86.5	2.0	4	7.5	10	106	

[1] Less than 1.

TABLE Bs-7.—*Big Sandy River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Levisa Fork, station 8.2, dam No. 1	BsL 35	June 23, 1939		23.0	6.8	78.3	1.5	240		170	30	
Levisa Fork, station 2.7, Walbridge Highway Bridge.	BsL 30	Aug. 4, 1939		26.5	6.9	84.7	.7	46				
Do	do	Aug. 18, 1939		26.0	6.5	79.1	.9	240				
Do	do	Sept. 1, 1939		23.5	6.3	73.0	1.2	23	7.7	18	54	
Do	do	Sept. 15, 1939		25.0	7.0	83.5	.4	4				
Do	do	Sept. 29, 1939		22.5	7.8	89.1	.5	1				
Do	do	Oct. 13, 1939		17.5	6.7	69.3	1.0	4				
Do	do	Oct. 27, 1939		18.0	8.2	85.8	1.0	(1)				
Do	do	Nov. 10, 1939		7.5	10.4	86.9	.8	2				
Do	do	Nov. 24, 1939		8.5	9.0	76.9	.5	(1)				
Do	do	Dec. 8, 1939		5.5	10.8	85.4	.6	1				
Do	do	Dec. 29, 1939		2.5	13.3	97.5	1.3	1				
Do	do	Feb. 9, 1940		2.5	13.2	96.9	.6	2				
Do	do	Feb. 13, 1940		6.5	11.7	94.8	.9	46				
Do	do	Mar. 8, 1940		5.0	11.7	91.5	.5	39				
Do	do	Apr. 5, 1940		14.0	9.2	88.8	.5	93				
Levisa Fork, station 0.1, Fort Gay	BsL 27.6	July 7, 1939		25.0	5.8	69.2	2.0	460	7.3	900	21	
Do	do	July 21, 1939		23.0	6.6	75.5	1.7	240	7.1	1,000	25	
Do	do	Aug. 4, 1939		27.0	6.9	85.0	.6	110	7.5	85	40	
Do	do	Aug. 18, 1939		27.0	6.6	81.5	1.1	43	7.6	200	55	
Do	do	Sept. 1, 1939		25.0	7.3	86.6	.8	93				
Do	do	Sept. 15, 1939		25.0	7.0	83.1	.7	4	7.6	7	65	
Do	do	Sept. 29, 1939		23.5	7.8	90.8	1.5	11	7.6	5	79	
Do	do	Oct. 13, 1939		17.5	7.9	82.1	.9	43	7.7	12	81	
Do	do	Oct. 27, 1939		18.0	8.2	86.2	.8	43	7.6	12	90	
Do	do	Nov. 10, 1939		8.0	9.6	80.4	1.0	23	7.5	18	84	
Do	do	Nov. 24, 1939		7.5	9.7	80.8	.8	2	7.5	8	83	
Do	do	Dec. 8, 1939		5.0	11.4	89.2	.7	24	7.4	9	107	
Do	do	Dec. 29, 1939		1.5	13.5	96.1	1.1	2	7.2	7	70	
Do	do	Feb. 9, 1940		2.0	13.4	96.5	.8	2	6.8	16	45	
Do	do	Feb. 13, 1940		5.5	11.7	92.8	1.6	110	7.6	190	28	
Do	do	Mar. 8, 1940		4.5	11.8	91.2	.6	21	6.9	52	21	
Do	do	Apr. 5, 1940		13.0	9.2	86.9	.7	93	6.6	95	20	
Big Sandy River, station 26.6, below Louisa, Ky.	Bs 26.6	June 23, 1939	3,930	27.0	6.4	79.4	2.1	460		300	32	
Do	do	July 7, 1939	10,200	25.5	5.9	71.1	1.9		7.1	1,100	21	
Do	do	July 21, 1939	4,300	23.0	6.9	79.0	1.6	460				
Do	do	Aug. 4, 1939	1,590	27.0	7.1	88.0	.6	24	7.4	50	41	

Do	do	Aug. 18, 1939	1,300	26.5	6.5	79.3	2.2	93	7.6	300	61	----------
Do	do	Sept. 1, 1939	275	25.5	7.7	92.8	1.1	240	7.8	7	55	----------
Do	do	Sept. 15, 1939	185	25.5	7.4	89.0	1.1	75	7.7	6	68	----------
Do	do	Sept. 29, 1939	95	23.0	8.1	93.1	.5	240	8.0	12	78	----------
Do	do	Oct. 13, 1939	102	19.5	8.2	88.6	.8	4	8.0	7	102	----------
Do	do	Oct. 27, 1939	72	19.0	8.5	91.1	1.3	----------	7.9	10	91	----------
Do	do	Nov. 10, 1939	102	7.0	10.0	82.4	.9	36	7.6	11	91	----------
Do	do	Nov. 24, 1939	87	7.5	9.9	82.3	1.0	46	7.6	8	90	----------
Do	do	Dec. 8, 1939	87	5.0	11.7	91.1	.8	93	7.3	9	115	----------
Do	do	Dec. 29, 1939	250	2.0	12.9	93.4	1.9	4	7.4	8	71	----------
Do	do	Feb. 13, 1940	2,840	6.0	11.4	91.2	1.7	24	7.6	130	46	----------
Do	do	Mar. 8, 1940	3,640	4.0	11.8	90.0	.6	39	6.9	45	23	----------
Do	do	Apr. 5, 1940	4,260	13.0	9.2	86.6	.6	43	6.6	95	22	----------
Big Sandy River, station 0.3, dam No. 1.	Bs 0.3	June 1, 1939	1,240	27.0	7.5	93.2	2.9	43	----------	14	39	----------
Do	do	June 5, 1939	2,520	27.5	7.9	98.5	2.5	23	----------	18	43	----------
Do	do	June 7, 1939	2,530	26.5	6.2	75.8	1.3	43	----------	230	43	----------
Do	do	June 9, 1939	2,110	27.0	6.5	80.2	1.2	23	----------	73	45	----------
Do	do	June 13, 1939	2,830	25.0	6.8	80.9	2.0	240	----------	183	34	----------
Do	do	June 15, 1939	1,760	25.0	6.9	81.9	1.1	93	----------	185	41	----------
Do	do	June 19, 1939	1,310	27.0	6.4	79.4	1.0	75	----------	90	39	----------
Do	do	June 21, 1939	5,230	27.0	7.6	94.1	1.2	240	----------	36	42	----------
Do	do	June 23, 1939	4,210	27.0	6.6	82.3	.8	240	----------	240	33	----------
Do	do	June 27, 1939	1,160	28.0	6.3	79.5	1.0	93	7.3	100	37	----------
Do	do	June 29, 1939	1,500	28.5	6.2	79.1	1.1	23	7.3	65	43	----------
Do	do	July 5, 1939	9,300	27.5	7.3	91.5	1.2	93	7.8	40	43	----------
Do	do	July 7, 1939	10,800	25.0	4.6	55.0	3.4	----------	7.0	1,250	19	----------
Do	do	July 11, 1939	3,330	26.5	6.6	81.6	1.1	91	7.2	240	32	----------
Do	do	July 13, 1939	2,180	27.5	6.8	85.6	----------	150	7.5	60	33	----------
Do	do	July 17, 1939	2,000	26.0	9.1	110.6	2.0	23	7.7	25	40	----------
Do	do	July 19, 1939	1,760	26.0	8.5	103.2	1.7	4	7.5	12	38	----------
Do	do	July 21, 1939	4,910	24.0	6.6	77.1	1.3	24	7.2	600	26	----------
Do	do	July 25, 1939	2,850	26.5	7.1	87.2	.6	46	7.2	60	39	----------
Do	do	July 27, 1939	3,190	28.0	6.8	86.1	1.0	46	7.2	125	38	----------
Do	do	July 31, 1939	4,330	26.0	6.7	82.0	.9	75	7.5	250	32	----------
Do	do	Aug. 2, 1939	3,080	26.5	7.4	91.3	.6	43	7.3	75	31	----------
Do	do	Aug. 4, 1939	1,710	27.0	7.0	96.7	1.6	93	7.5	80	37	----------
Do	do	Aug. 8, 1939	680	27.0	8.1	99.9	1.9	9	7.7	28	47	----------
Do	do	Aug. 10, 1939	350	27.0	8.1	100.0	2.1	9	7.4	27	49	----------
Do	do	Aug. 14, 1939	610	28.0	6.8	85.8	1.5	9	7.7	75	57	----------
Do	do	Aug. 16, 1939	820	28.0	7.2	91.3	1.1	24	7.7	30	69	----------
Do	do	Aug. 18, 1939	1,370	29.0	7.2	92.1	1.0	9	7.7	23	74	----------
Do	do	Aug. 22, 1939	1,010	26.0	7.4	90.2	1.4	9	7.6	34	54	----------
Do	do	Aug. 24, 1939	260	26.0	8.9	108.0	1.7	8	7.7	10	56	----------
Do	do	Aug. 28, 1939	325	26.0	7.0	85.2	1.2	24	7.6	18	68	----------
Do	do	Aug. 30, 1939	340	25.5	6.1	74.0	1.8	9	7.5	10	60	----------
Do	do	Sept. 1, 1939	300	26.5	7.7	94.7	1.6	240	7.6	14	61	----------
Do	do	Sept. 6, 1939	233	25.5	4.9	58.4	1.1	460	7.1	55	52	----------
Do	do	Sept. 8, 1939	262	26.5	6.0	73.2	1.4	91	7.7	27	64	----------
Do	do	Sept. 12, 1939	230	26.0	6.4	78.1	1.3	430	7.7	10	67	----------

[1] Less than 1.

TABLE Bs-7.—*Big Sandy River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Big Sandy River, station 0.3, dam No. 1.	Bs 0.3	Sept. 14, 1939	198	27.5	6.2	77.3	1.2	91	7.6	10	74	
Do	do	Sept. 18, 1939	134	25.5	6.1	72.9	1.0	230	7.6	7	75	
Do	do	Sept. 20, 1939	197	25.5	5.9	70.8	1.3	30	7.4	10	73	
Do	do	Sept. 22, 1939	134	24.0	5.2	60.7	1.1	75	7.5	12	79	
Do	do	Sept. 26, 1939	134	23.0	6.0	69.4	1.2	75	7.6	10	80	
Do	do	Sept. 28, 1939	134	26.0	6.2	75.0	1.1	240	7.6	5	81	
Do	do	Oct. 2, 1939	110	21.5	6.1	68.7	1.0	36	7.6	12	81	
Do	do	Oct. 4, 1940	104	22.0	6.5	73.3	1.0	91	7.7	8	81	
Do	do	Oct. 6, 1939	110	21.0	6.1	67.7	1.0	23	7.8	12	86	
Do	do	Oct. 10, 1939	110	24.5	7.1	83.7	1.7	110	7.8	7	88	
Do	do	Oct. 12, 1939	109	24.5	6.6	78.3	1.0	23	7.8	7	89	
Do	do	Oct. 16, 1939	93	19.0	6.7	71.3	1.0	93	7.6	8	93	
Do	do	Oct. 18, 1939	93	17.0	6.6	68.2	1.0	93	7.7	8	93	
Do	do	Oct. 20, 1939	93	19.0	7.1	75.7	1.2	43	7.7	8	96	
Do	do	Oct. 24, 1939	93	18.5	6.2	65.8	1.3	23	7.5	5	100	
Do	do	Oct. 26, 1939	77	20.0	6.4	69.8	1.4	240	7.7	97	15	
Do	do	Oct. 30, 1939	130	17.5	5.0	52.1	1.5	240	7.3	21	94	
Do	do	Nov. 1, 1939	84	17.5	5.7	59.5	1.4	43	7.3	17	96	
Do	do	Nov. 3, 1939	118	11.5	5.9	54.2	1.4	43	7.3	13	97	
Do	do	Nov. 7, 1939	112	13.5	6.4	60.9	1.6	93	7.2	10	104	
Do	do	Nov. 9, 1939	111	14.0	6.5	62.6	1.8	43	7.3	8	98	
Do	do	Nov. 13, 1939	95	11.5	5.3	48.4	2.7	4	7.2	11	95	
Do	do	Nov. 15, 1939	95	12.5	5.7	53.0	2.4	46	7.3	8	90	
Do	do	Nov. 17, 1939	95	14.0	5.7	55.0	3.6	24	7.2	12	85	
Do	do	Nov. 27, 1939	79	10.0	6.6	58.0	2.1	93	7.3	8	103	
Do	do	Nov. 29, 1939	95	9.0	7.4	64.0	2.0	93	7.4	9	96	
Do	do	Dec. 1, 1939	79	10.0	8.1	71.6	1.8	23	7.3	11	99	
Do	do	Dec. 5, 1939	95	10.0	7.8	68.8	2.1	43	7.3	7	103	
Do	do	Dec. 7, 1939	95	10.5	7.7	68.9	2.4	240	7.3	8	101	
Do	do	Dec. 11, 1939	95	9.0	6.9	59.9	2.8	43	7.2	7	100	
Do	do	Dec. 13, 1939	95	10.5	7.2	63.9	2.5	9	7.4	6	98	
Do	do	Dec. 15, 1939	79	10.5	7.3	64.7	2.4	93	7.1	6	99	
Do	do	Dec. 19, 1939	103	10.5	7.5	66.9	1.7	23	7.4	7	99	
Do	do	Dec. 21, 1939	117	10.0	7.8	69.1	1.8	43	7.5	8	101	
Do	do	Dec. 26, 1939	222	6.0	8.0	63.8	1.6	43	7.7	5	99	
Do	do	Dec. 28, 1939	277	7.0	8.7	71.6	1.5	43	7.4	6	98	
Do	do	Jan. 2, 1940	483	.5	13.3	92.2	1.3	4	7.2	8	83	
Do	do	Jan. 12, 1940	250	3.0	10.2	75.8	.9	110	6.9	25	86	

Do	do	Jan. 16, 1940	884	.5	12.9	89.3	1.2	23	6.9	80	49	
Do	do	Feb. 15, 1940	4,470	2.5	12.4	90.5	1.5	43	7.0	150	23	
Do	do	Feb. 19, 1940	6,400	2.5	12.4	90.9	1.8	43	6.9	250	25	
Do	do	Feb. 21, 1940	5,900	5.0	11.7	91.5	1.0	23	6.9	120	19	
Do	do	Feb. 23, 1940	5,240	3.5	11.9	89.7	.9	15	6.9	55	19	
Do	do	Feb. 27, 1940	2,000	3.5	12.6	94.4	1.5	150	7.1	160	28	
Do	do	Feb. 29, 1940	3,350	3.5	12.3	92.3	1.1	23	7.0	100	25	
Do	do	Mar. 4, 1940	10,300	8.5	10.6	90.2	1.6	43	7.0	350	25	
Do	do	Mar. 6, 1940	6,750	7.5	10.5	87.4	.8	15	7.3	170	20	
Do	do	Mar. 8, 1940	4,200	6.5	11.1	90.1	1.1	43	6.8	52	21	
Do	do	Mar. 12, 1940	1,830	4.5	12.2	94.1	.7	7	6.9	34	24	
Do	do	Mar. 14, 1940	1,720	5.0	12.6	98.3	.7	460	6.8	21	27	
Do	do	Mar. 18, 1940	4,730	7.5	11.5	96.0	1.0	9	6.8	45	30	
Do	do	Mar. 20, 1940	4,580	9.0	10.8	93.3	.9	75	7.1	35	22	
Do	do	Mar. 22, 1940	5,630	8.5	10.8	92.5	.6	93	6.8	32	23	
Do	do	Mar. 26, 1940	1,960	4.0	12.4	94.5	1.0	9	6.7	20	25	
Do	do	Mar. 28, 1940	1,620	7.0	11.9	97.9	.5	9	6.6	10	27	
Do	do	Apr. 1, 1940	15,730	9.5	9.7	85.0	1.5	110	6.8	260	19	
Do	do	Apr. 3, 1940	9,190	12.5	9.3	86.8	1.1	43	7.0	21	65	
Do	do	Apr. 5, 1940	4,740	13.0	9.3	88.0	.7	75	6.5	37	20	
Do	do	Apr. 9, 1940	3,720	11.5	10.8	98.8	.6	23	6.7	25	24	
Do	do	Apr. 11, 1940	3,620	11.5	10.1	92.3	.6	43	6.7	18	25	

[1] Less than 1.

GUYANDOT RIVER BASIN

CONTENTS

	Page
Contents	563
Syllabus and conclusions	565
Description	566
Presentation of field data	567
Presentation of laboratory data	569
Hydrometric data	570
Discussion	571

LIST OF TABLES

Gy–1.—Cost estimates of remedial measures	566
Gy–2.—Surface water supplies	567
Gy–3.—Sources of pollution	568
Gy–4.—Industrial wastes (omitted; not significant).	
Gy–5.—Selected laboratory data	569
Gy–6.—Monthly mean summer flows	570
Gy–7.—Summary of laboratory data	572

LIST OF FIGURES

Gy–2. Chart—Sources of pollution and selected laboratory data	568

(NOTE.—For maps of this basin see Big Sandy River Basin)

GUYANDOT RIVER BASIN[1]

Syllabus and Conclusions

SYLLABUS

The Guyandot Basin, comprising 1,670 square miles in the mountains of southern West Virginia, is an important coal mining area and is similar to the Big Sandy River Basin to the west. Only about 5 percent of the total population of 148,000 is urban. Sanitary conditions are poor. Pollution is uncontrolled, causes local damage, and affects public water supplies. Acid mine drainage and coal washery wastes damage tributary streams. Techniques are available for abatement of the pollution but the needs of the people in other directions limit present justifiable correction to partial treatment.

CONCLUSIONS

(1) There are 17 public water supplies taken from surface sources, of which 5 are from streams receiving sewage from one or more communities above the water intake. At the largest of these, Logan, local sewage affects the water supply.

(2) Sewage from a population of 23,900 is discharged without treatment. The Guyandot River is not heavily polluted. The largest sources of pollution are at Logan and Mullens. There are no organic industrial wastes of consequence, although coal washery wastes and acid mine drainage damage a few tributary streams. About half of the acid mine drainage load has been removed by sealing abandoned mines.

(3) Laboratory studies show that the effects of pollution are primarily local and that the Guyandot River at Logan and above presents the major pollution problem. The streams recover rather quickly from the effects of pollution and are in relatively good condition at short distances below the sources of pollution.

(4) Low-flow argumentation by flood-control reservoirs would not have any appreciable value for pollution abatement.

(5) Primary treatment of all sewage would be sufficient to maintain good stream conditions at most places. At some communities, where stream flows approach zero, secondary treatment would be required to prevent local nuisances. Considering the present financial condition of the towns, justification for the expenditure beyond partial treatment is questionable.

---

[1] For maps of this basin, see Big Sandy River Basin.

(6) A summary of cost estimates of remedial measures from table Gy-1 follows:

Treatment	Capital cost	Annual charges
Existing	0	0
Suggested additional	$530,000	$45,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are—

Treatment	Capital cost	Annual charges
Primary, all places	$530,000	$45,000
Secondary, all places	730,000	70,000

Table Gy-1.—*Guyandot River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment				0	0	0	0
Suggested minimum correction:							
Sewage treatment plants	13	0	19,700	$300,000	$20,000	$15,000	$35,000
Required interceptors				230,000	10,000		10,000
Independent industrial waste correction							
Total				530,000	30,000	15,000	45,000
Comparative cost:							
Primary treatment all waste				530,000	30,000	15,000	45,000
Secondary treatment all waste				730,000	47,000	23,000	70,000
As suggested				530,000	30,000	15,000	45,000

Description

The Guyandot River drains 1,670 square miles of mountainous country in southern West Virginia and joins the Ohio River at Huntington, W. Va. Its only important tributary is the Mud River which drains 358 square miles and joins the Guyandot 7 miles above its mouth. With the development of coal mining the population of the basin has increased as shown below:

	1910	1920	1930	1940
Rural	61,630	89,900	117,233	140,065
Urban		2,998	4,396	8,192
Total	61,630	92,898	121,629	148,257

The only towns of urban size are Logan (population 5,166) and Mullens (population 3,026). Much of the rural population is in mining camps which are concentrated in the vicinity of Logan and in the extreme southeastern part of the basin.

Water uses.—The Guyandot is not navigable except near its mouth where it is affected by backwater from the Ohio. There are no hydroelectric power developments nor are there any proposed. No flood-control projects have been built but a reservoir above Milton on Mud River has been considered by the United States Engineer Department in connection with the authorized program for Ohio River flood control. The Guyandot and some of its tributaries are considered fairly good bass fishing streams and are extensively used by local residents, but there are no developed recreation areas.

Presentation of Field Data

Figure Bs–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure Gy–2 shows similar data and, in addition, the location of water-supply intakes below sources of pollution and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Eighty-nine public water supplies in the basin serve 61,500 people. Only 17 of these are from surface sources and only 5 of the surface supplies come from streams subject to pollution. Table Gy–2 shows data on the surface supplies. The underground water is usually quite hard and is limited in quantity. A number of the communities use mine drainage as a source of water.

Table Gy–2.—*Guyandot River Basin: Surface water supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
Logan	West Virginia.	Guyandot River	82	FD	9,000	0.50
Man	do	do	93	FD	1,000	.04
Milton	do	Mud River	24	FD	1,400	.06
Monaville	do	Island Creek, Mill Creek	84	ILD	800	.04
Amherstdale	do	Mine, Buffalo Creek	99	D	700	.03
	Other surface supplies					
Whitman	West Virginia.	Mine, Whitman Creek	84	FD	1,500	0.06
Shegon	do	Well, Mud Fork	85	FD	600	.04
Holden Mine No. 22	do	Well, Pine Creek	94	ILD	500	.06
Omar [3]	do	Well, Little Creek	92	D	2,000	.15
Barnabus [3]	do	do	92	D	200	.02
Stirrat [3]	do	do	92	D	1,500	.08
Slagle	do	Rum Creek, well	94	D	700	.03
Macbeth	do	Mine, small stream		D	400	.02
Earling	do	do		D	700	.02
Amherstdale (Becco)	do	do		None	800	.04
Covel	do	Small stream		[4]	300	.01
Wacomah	do	Small stream—mine		None	100	.01
Total:						
Below sewer outfalls					12,900	0.67
Other					9,300	.54
Total surface water supplies					22,200	1.21

[1] Miles above mouth of Guyandot River.
[2] F=Coagulated, settled, filtered, I=Iron removal, L=Lime, soda softened, D=Chlorinated.
[3] These three towns have separate systems and wells for use during summer. During the winter they are all served by supply from Little Creek above Stirrat.
[4] Filtered, no coagulants.

Sewerage.—Table Gy–3 shows the sewered population at each of the more important sources of pollution in the basin. Less than half of the people served by water supplies are connected to sewers. None of the sewage is treated. In addition to this sewage, a considerable amount of polluting matter reaches the stream from insanitary privies overhanging the streams or on the stream banks. Garbage and other refuse is commonly dumped into the streams.

TABLE GY–3.—*Guyandot River Basin: Sources of significant pollution including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Receiving stream	Miles above mouth of Guyandot River	Population connected to sewers	Treatment	Sewered population (equivalent biochemical oxygen demand)	
					Untreated	Discharged
Merrill	Guyandot River	77	500	None	500	500
West Logan	do	78	900	do	900	900
Peach Creek	Guyandot River-Peach Creek.	78	500	do	500	500
Logan [1]	Guyandot River-Island Creek.	81	5,900	do	5,900	5,900
Stollings-McConnell	Guyandot River	83	600	do	600	600
Man	Guyandot River-Buffalo Creek.	94	1,100	do	1,100	1,100
Pineville	Guyandot River	143	700	do	700	700
Mullens	Guyandot River-Slab Fork.	156	2,300	do	2,300	2,300
Barboursville	Mud River	8	1,400	do	1,400	1,400
Milton	do	24	600	do	800	800
Hamlin	do	44	900	do	900	900
Holden	Copperas Mine Fork	84	1,000	do	1,000	1,000
Holden Mine No. 22	Pine Creek	94	500	do	500	500
Omar	Island Creek-Pine Creek	89	1,600	do	1,600	1,600
Helen	Winding Gulf Creek-Berry Branch.	165	1,200	do	1,200	1,200
21 smaller sources			4,200	do	4,200	4,200
Total			23,900		24,100	24,100

[1] Including some adjoining communities.

Industrial wastes.—The only industry in the basin discharging organic wastes is a small cannery at Milton. Most of the 25 coal washeries in the basin cause some pollution by the discharge of fine coal particles which make the streams turbid and blanket the bottom. The steam-electric power plant at Logan dumps ashes from about 900 tons of coal per day into the Guyandot River.

Acid mine drainage causes damage to some of the tributary streams but has no great effect on the main stream. Island Creek receives most of the acid drainage. The original acid load has been reduced by about 46 percent by the mine-sealing program formerly in operation in the area. Most of the remaining acid comes from active mines.

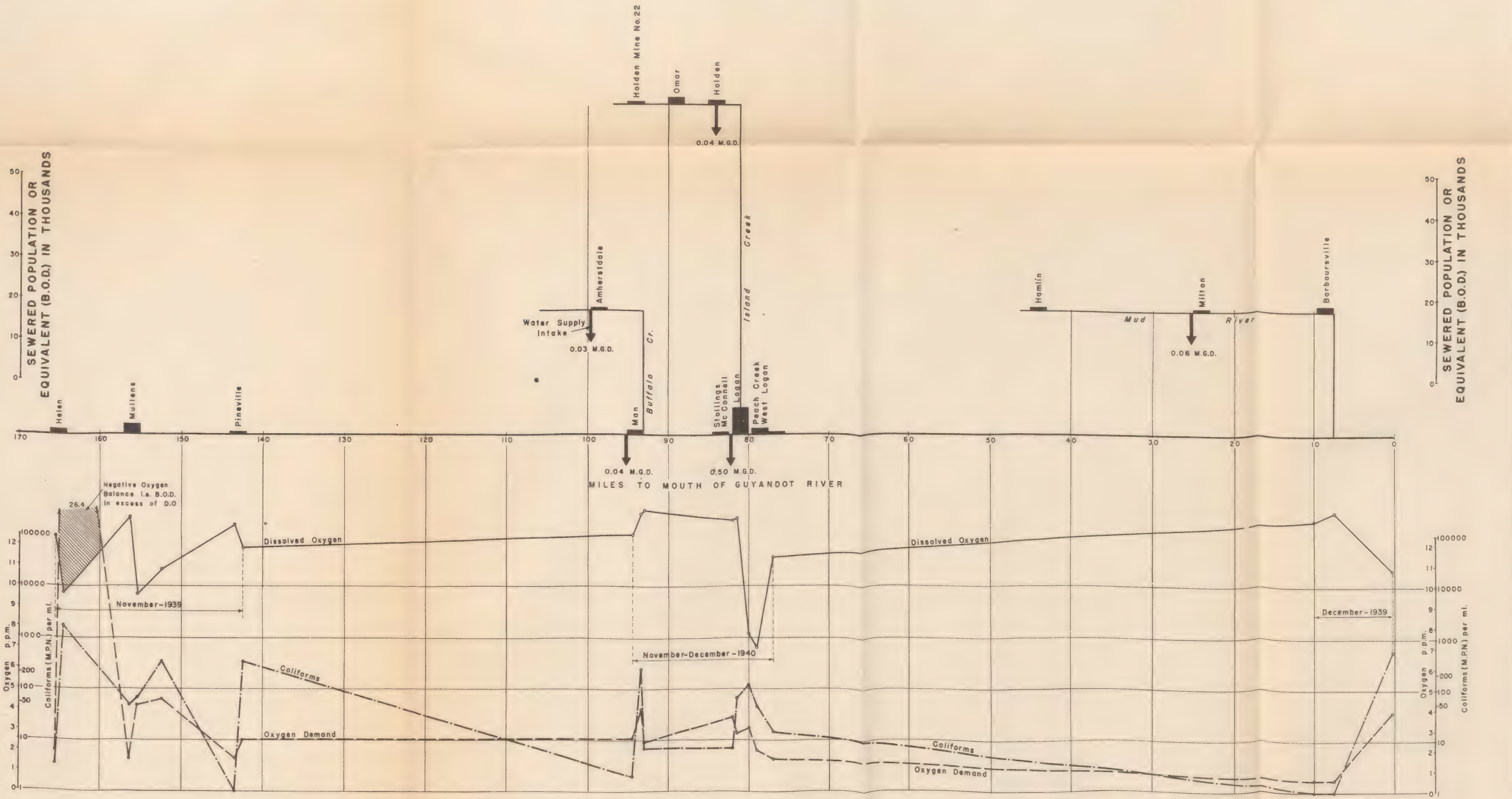


FIGURE - Gy 2

GUYANDOT RIVER

SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

GPO-43 O-80035

PRESENTATION OF LABORATORY DATA

A tabulated summary of the laboratory results is presented in table Gy–7 (p. 572). Selected data are in table Gy–5.

TABLE GY–5.—*Guyandot River Basin: Selected laboratory data—main stream and tributaries*

River	Guyandot	Guyandot	Guyandot	Guyandot	Guyandot	Guyandot	Guyandot
Location	Above Mullens	Below Mullens	Above Pineville	Below Pineville	Above Man	Below Man	Above Logan
River miles above mouth of Guyandot.	156.5	155.5	143.5	142.5	94.5	93.5	82
Period, 1939							
Number of samples	2	2	2	2	3	2	3
Flow in cubic feet per second: Sampling days					28	30	
Water temperature, °C	1.5	1.5	2.5	2.3	5.7	5.5	5.7
Coliforms per milliliter	46	66	(1)	330	2	242	7
Dissolved oxygen parts per million	13	9.6	13.0	11.9	12.5	13.5	13.2
Biochemical oxygen demand, 5-day, parts per million	1.6	4.2	1.6	2.5	2.6	4.0	3.6

River	Guyandot	Guyandot	Guyandot	Guyandot	Winding Gulf Creek	Island Creek	Copperas Mine Fork
Location	Water intake, Logan	Below Logan	Below Chapmansville	Below Barboursville	Below Helen	Below Omar	Below Holden
River miles above mouth of Guyandot.	81.5	80	77	7.5	164.5	88.5	84
Period, 1939							
Number of samples	3	3	2	1	2	2	2
Flow in cubic feet per second: Sampling days		37	37				
Water temperature, °C	5.0	10.3	6.5	1.5	3.5	5.8	7.3
Coliforms per milliliter	64	118	13	0	1,750	1,670	41
Dissolved oxygen, parts per million	13.3	7.7	11.4	13.6	9.6	8.4	8.9
Biochemical oxygen demand, 5-day, parts per million	2.8	3.1	1.6	.6	26.4	21.2	13.2

[1] Less than 1.

Laboratory observations in the Guyandot Basin were carried out largely by a mobile laboratory unit during November and December 1939. Observations at the mouth were made from two to four times monthly during the 10-month period from June 1939 to April 1940 by the laboratory boat *Kiski* from Ashland. The *Kiski* also made observations at Barboursville and along the Mud River.

Figures Bs–3, Bs–4, and Bs–5 present graphically on spot symbol maps the results of the coliform, dissolved oxygen, and oxygen demand determinations at the several sampling points. The results thus presented are averages of from one to three determinations from those points sampled during a period of less than 1 month and represent the most unfavorable monthly average where observations were made over a period of several months.

The Guyandot River above Logan presents the major pollution problem in the basin. Points below Logan and on the Mud River show little pollution except at the mouth where the results are affected

by Huntington's sewage. The coliform and oxygen-demand results are in good agreement as to the major sources of pollution—Helen, Mullens, Man, Omar, Holden, and Logan being the more marked sources of pollution. The dissolved oxygen results presented a uniformly good picture.

The stream recovered sufficiently between one source of pollution and the next to produce relatively good conditions at those stations above town. Considerable coliforms and oxygen-demand reduction is apparent in these stretches despite the rather cool weather. Stream flows in general were low during the sampling period except in the area sampled from the *Kiski.*

Acid stream conditions were found along Island Creek and its tributary Copperas Mine Fork, pH values ranged from 4.5 to 5.2 and phenolphthalein acidities from about 20 to more than 200 parts per million.

The laboratory results indicate that the effects of pollution on the Guyandot were primarily local under the low stream flow conditions existing at most stations during the time of this survey.

Biological summary.—The Guyandot is heavily polluted in the upper reaches by mine drainage, which renders that portion of the stream unsuitable for aquatic life. The plankton volume of less than 500 parts per million indicates that the entire stream is comparatively free from organic pollution.

Hydrometric Data

Four stream-gaging stations have been maintained in the Guyandot Basin at various times and two are currently operated. Table Gy–6 shows mean monthly flows during the summer months at these two stations for some of the dryer years of record.

Table Gy–6.—*Guyandot River Basin: Monthly mean summer flows for years in which lowest summer flows have occurred*

River	Guyandot	Guyandot
Location	Man	Branchland
River miles above mouth of Guyandot	94	34
Drainage area (square miles)	762	1,226
Period of record	1929–40	1929–40
Year	1930	1930
June ... cubic feet per second	53.5	79.8
July ... do	12.3	15.1
August ... do	42.1	48.4
September ... do	9.5	21.8
Year	1932	1932
June ... cubic feet per second	923	1,460
July ... do	956	2,090
August ... do	186	245
September ... do	31.4	42.4
Year	1939	1939
June ... cubic feet per second	730	833
July ... do	690	1,010
August ... do	152	254
September ... do	37	50.5

Low-flow regulation.—There are no flood-control or hydro-electric reservoirs in the basin at present. One reservoir has been authorized by the Congress as part of the comprehensive program for Ohio River flood control. This is on the Mud River above Milton and could be operated to increase the minimum flow below the reservoir by about 22 cubic feet per second. However, this additional flow would not reduce the degree of treatment required at down-stream communities and the benefits would be largely intangible.

Discussion

The pollution problems of the Guyandot are primarily local ones. At most of the communities primary treatment of all sewage would be sufficient to maintain good oxygen conditions. At some of the towns on tributaries, stream flows become so low that secondary treatment probably would be needed to prevent local nuisances.

At Logan, sewage from the adjoining communities should be intercepted and treated with Logan's wastes. This is particularly desirable in the case of Stollings and McConnell whose sewage enters the Guyandot above Logan's water intake.

Because of the local nature of the pollution problems of the basin and the character of the communities it is suggested that partial treatment of all sewage be provided. Secondary treatment can be added as community finances permit.

Most of the coal washeries are equipped to recover the fine particles which now enter the streams at some of the plants. Those washeries not now equipped to recover the sludge should be so equipped and greater care in operation should be practiced to prevent the discharge of coal dust to the streams.

The estimated cost of the suggested pollution abatement program is summarized in table Gy–1.

TABLE GY-7.—*Guyandot River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Winding Gulf Creek, above Helen, W. Va.	GyWg 165.5	Nov. 13, 1939		4.5	12.8	98.8	1.7	46	7.9	5	173	
Do	do	Nov. 16, 1939		1.0	12.0	84.1	2.3	23	7.8	110	211	305
Winding Gulf Creek, below Helen, W. Va.	GyWg 164.5	Nov. 13, 1939		7.0	10.8	88.7	38.6	1,100	7.7	93	171	
Do	do	Nov. 16, 1939		0	8.5	57.9	14.2	2,400	7.9	15	189	295
Guyandot River, above Mullens, W. Va.	Gy 156.5	Nov. 13, 1939		3.0	13.1	96.9	1.5		7.9	5	152	
Do	do	Nov. 16, 1939		0	13.5	92.6	1.7	46	7.6	12	148	195
Guyandot River, below Mullens, W. Va.	Gy 155.5	Nov. 13, 1939		3.0	9.3	68.8	3.8	93	7.7	7	144	
Do	do	Nov. 16, 1939		0	10.0	68.2	4.6	39	7.6	3	134	215
Guyandot River, below mouth Barkers Creek.	Gy 152.5	Nov. 13, 1939		2.5	10.6	77.5	3.7	460	7.7	2	142	
Do	do	Nov. 16, 1939		.5	11.0	76.1	5.3	240	7.8	8	128	175
Guyandot River, above Pineville, W. Va.	Gy 143.5	Nov. 13, 1939		4.0	11.9	90.9	1.7	(1)	7.8	3	115	
Do	do	Nov. 16, 1939		1.0	14.0	98.7	1.6	(1)	7.7	3	106	401
Guyandot River, below Pineville, W. Va.	Gy 142.5	Nov. 13, 1939		3.5	10.9	81.9	2.7	430	7.7	5	113	
Do	do	Nov. 16, 1939		1.0	12.8	90.2	2.4	230	7.6	0	125	117
Guyandot River, above Man, W. Va.	Gy 94.5	Nov. 27, 1939		5.5	13.3	105.3	2.0	4	7.6	6	101	120
Do	do	Nov. 30, 1939		6.0	12.2	98.2	1.0	1	7.6	2	103	
Do	do	Dec. 5, 1939		5.5	11.9	93.9	5.0	2	7.5	2	91	
Buffalo Creek, above Man, W. Va.	GyB 94.5	Nov. 27, 1939	2	5.0	11.3	88.0	2.6	460	7.4	5	44	320
Do	do	Nov. 30, 1939	2	6.0	11.6	93.2	2.4	43	6.9	2	50	
Do	do	Dec. 5, 1939	2	5.0	11.5	90.0	4.1	460	7.0	23	46	
Guyandot River, near sewer, below Man, W. Va.	Gy 93.5	Nov. 30, 1939	27	5.5	12.8	101.0	2.1	23	7.6	0	151	
Do	do	Dec. 5, 1939	33	5.5	14.3	113.1	5.9	460	7.7	3	97	
Guyandot River, below Man, W. Va.	Gy 93	Nov. 27, 1939	30	6.5	13.7	111.1	2.4	7	7.9	2	95	120
Guyandot River, above Logan, W. Va.	Gy 82	Nov. 27, 1939		6.0	12.4	99.7	3.1	(1)	7.6	0	94	120
Do	do	Nov. 30, 1939		6.5	12.6	102.1		(1)	7.6	0	99	
Do	do	Dec. 5, 1939		4.5	14.7	113.6	4.0	24	7.6	2	106	
Guyandot River waterworks intake above Logan, W. Va.	Gy 81.5	Nov. 27, 1939		6.0	13.1	104.6	3.0	93	7.7	12	89	180
Do	do	Nov. 30, 1939		4.5	12.6	97.4	1.6	75	7.6	3	95	
Do	do	Dec. 5, 1939		4.5	14.3	109.9	3.8	23	7.5	2	97	

[1] Less than one.

TABLE GY-7.—*Guyandot River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Island Creek, near sewer, Omar, W. Va.	GyI 88.5	Nov. 30, 1939		8.0	6.7	56.2	19.9	2,400	7.1	18	116	
Do	do	Dec. 5, 1939		3.5	10.0	75.6	22.5	930	7.1	87	105	
Island Creek, below Omar, W. Va.	GyI 88.0	Nov. 27, 1939		7.0	11.5	94.2	7.2	91	7.7	18	75	140
Island Creek, below Monitor, W. Va.	GyI 85.0	Nov. 28, 1939		1.5	11.8	84.2	2.3	36	6.8	8	26	580
Do	do	Dec. 1, 1939		7.5	10.5	87.2	4.8	([1])	5.2	20		
Do	do	Dec. 6, 1939		6.0	11.0	88.3	1.1	4	6.4	1,800	21	
Copperas Mine Fork, below Holden, W. Va.	GyICm 84	Nov. 28, 1939		5.0	9.8	76.6	15.5	43	5.2	260		2,070
Do	do	Dec. 1, 1939		9.5	7.9	69.3	11.0	39	4.8	395		
Island Creek at mouth	GyI 81	Nov. 28, 1939	2	1.5	10.2	72.3	8.2	280	5.4	220		900
Do	do	Dec. 1, 1939	3	8.0	8.0	67.6	9.5	230	4.5	165		
Do	do	Dec. 6, 1939	3	6.5	9.7	78.4	3.6	91	4.7	520		
Guyandot River, below Logan, W. Va.	Gy 80	Nov. 28, 1939	35	9.0	8.1	70.0	1.8	91	7.1	20	71	210
Do	do	Dec. 1, 1939	34	13.0	6.9	65.5	2.3	240	7.1	8	75	
Do	do	Dec. 6, 1939	42	9.0	8.2	70.6	5.1	23	6.8	13	45	
Guyandot River, bridge at Henlawson, W. Va.	Gy 79	Nov. 28, 1939	35	8.0	7.5	63.1	2.4	43	7.1	32	69	250
Do	do	Dec. 1, 1939	34	11.5	6.6	60.3	1.6	43	7.2	2	85	
Guyandot River, below Chapmansville, W. Va.	Gy 77	Nov. 28, 1939	35	5.0	11.8	92.0	1.6	23	7.4	12	74	240
Do	do	Dec. 1, 1939	34	8.0	11.0	92.4	1.6	3	7.4	5	60	
Guyandot River, 2 miles above Barboursville, W. Va.	Gy 10	Dec. 15, 1939		1.5	13.2	94.2	.6	0				
Do	do	Jan. 19, 1940		1.0	13.6	95.7	2.0	1				
Do	do	Feb. 2, 1940		0	10.3	70.6	.6	([1])	6.8	5		
Do	do	Feb. 16, 1940		1.0	13.5	95.1	.6	11				
Do	do	Feb. 23, 1940		4.5	12.3	94.7	.6					
Do	do	Mar. 15, 1940		3.5	12.2	91.9	.4	23				
Do	do	Mar. 28, 1940		9.0	11.6	100.3	.2	0				
Do	do	Apr. 4, 1940		16.5	9.3	94.3	.4	15				
Mud River, 0.1 mile above Hamlin, W. Va., Route No. 3.	GyM 45	Mar. 29, 1940		12.5	10.1	94.2	.2	23				
Do	do	Apr. 4, 1940		14.5	9.3	90.6	.3	15				
Mud River, 1.1 mile below Hamlin, W. Va.	GyM 43	Mar. 29, 1940		12.0	9.9	91.4	.2	23	6.8	8	27	
Do	do	Apr. 4, 1940		15.5	9.0	89.1	.5	39	6.9	18	21	

Mud River, 0.1 mile above Milton, W. Va., U. S. Route No. 60.	GyM 25	Mar. 28, 1940		9.5	11.1	96.9	.3	43				
Do	do	Apr. 4, 1940		13.5	9.2	88.3	.8	15				
Mud River, 1.1 mile below Milton, W. Va.	GyM 23	Mar. 28, 1940		9.0	11.1	95.6	.5	9	6.7	8	30	
Do	do	Apr. 4, 1940		14.0	9.2	88.3	1.0	43	6.8	33	25	
Guyandot River, below corporation, Barboursville, W. Va.	Gy 7.5	Dec. 15, 1939		1.5	13.6	96.7	.6	0	7.0	5	60	
Do	do	Jan. 19, 1940		1.0	13.7	96.3	2.4	9	6.9	12	39	
Do	do	Feb. 2, 1940		.5	10.4	72.4	.7	2	6.8	5	44	
Do	do	Feb. 16, 1940		1.0	13.3	93.7	.9	110	6.6	60	19	
Do	do	Feb. 23, 1940		4.0	12.3	93.6	1.1	9	6.7	70	15	
Do	do	Mar. 15, 1940		3.5	12.2	92.0	.8	9	6.6	24	20	
Do	do	Mar. 28, 1940		9.0	11.7	101.0	.3	4	6.6	6	18	
Do	do	Apr. 4, 1940		15.5	9.5	94.1	.4	24	6.9	9	15	
Guyandot River, Cabell County Highway Bridge.	Gy 0.1	June 23, 1939	420	26.5	6.8	84.0	1.3	240	7.2	110	23	
Do	do	June 29, 1939	1,600	25.0	6.7	79.9	.8	460		700	16	
Do	do	July 7, 1939	3,475	25.5	6.4	77.1	1.8	11,000	7.2	600	19	
Do	do	July 13, 1939	690	25.5	7.1	85.6	.4	240	7.5	150	18	
Do	do	July 21, 1939	2,247	23.0	7.6	87.3	1.4	460	7.2	380	30	
Do	do	July 27, 1939	931	27.0	7.2	89.0	.9	93	7.2	15	26	
Do	do	Aug. 4, 1939	674	25.5	6.8	81.8	1.1	460	7.4	100	26	
Do	do	Aug. 10, 1939	349	25.5	6.8	81.3	.9	240	7.3	28	32	
Do	do	Aug. 18, 1939	515	26.5	6.1	74.8	1.2	390	7.3	210	44	
Do	do	Aug. 24, 1939	182	25.5	6.8	81.9	1.3	430	7.5	22	42	
Do	do	Sept. 1, 1939	96	24.0	7.4	86.2	2.2	430	7.2	20	46	
Do	do	Sept. 6, 1939	124	23.5	6.0	69.8	1.2	4,600	7.3	20	49	
Do	do	Sept. 14, 1939	68	24.5	4.1	48.5	2.9	11,000	7.4	10	60	
Do	do	Sept. 20, 1939	53	23.0	6.9	79.4	1.4	2,400	6.7	5	44	
Do	do	Sept. 28, 1939	47	23.0	.1	.9	4.3	4,600	7.5	22	62	
Do	do	Oct. 6, 1939	58	19.0	6.4	68.2	2.1	2,400	7.6	18	53	
Do	do	Oct. 12, 1939	52	20.0	4.5	49.1	1.7	930	7.5	8	52	
Do	do	Oct. 20, 1939	39	16.5	5.8	59.1	4.4	4,600	7.5	22	45	
Do	do	Oct. 24, 1939	33	15.0	4.5	44.3	7.6	4,300	7.2	17	42	
Do	do	Nov. 3, 1939	50	10.0	8.4	73.8	4.5	930	7.2	23	49	
Do	do	Nov. 9, 1939	52	9.0	10.7	92.2	1.4	91	7.1	6	31	
Do	do	Nov. 17, 1939	47	9.0	9.8	84.7	17.0	11,000	6.9	17	49	
Do	do	Nov. 27, 1939	60	7.0	9.2	75.3	6.6	11,000	7.2	24	63	
Do	do	Dec. 5, 1939	83	5.5	10.0	79.1	5.2	1,500	7.2	12	59	
Do	do	Dec. 15, 1939	85	4.5	10.3	79.3	5.8	91	7.0	8	59	
Do	do	Dec. 21, 1939	117	6.5	10.3	83.5	3.0	150	7.4	9	64	
Do	do	Dec. 28, 1939	141	1.0	12.8	89.6	1.8	460	7.2	9	55	
Do	do	Feb. 21, 1940	4,347	5.0	11.9	93.1	.8	11	6.9	90	17	
Do	do	Feb. 27, 1940	3,390	3.0	12.6	93.8	1.5	460	7.0	42	16	
Do	do	Mar. 8, 1940	2,200	5.0	11.6	91.0	.6	23	6.9	25	19	
Do	do	Mar. 12, 1940	924	5.0	12.3	96.2	1.5	21	6.9	6	17	
Do	do	Mar. 20, 1940	1,860	9.0	11.1	96.0	.8	75	7.1	80	21	
Do	do	Mar. 28, 1940	756	7.0	11.7	96.0	.4	15	6.5	4	19	
Do	do	Apr. 5, 1940	3,594	13.0	9.3	87.8	.6	93	6.5	15	16	
Do	do	Apr. 11, 1940	2,323	11.5	10.2	92.8	.7	93	6.6	20	17	

[1] Less than one.

SCIOTO RIVER BASIN

90035—44—pt. 2——28

CONTENTS

	Page
Contents	577
Syllabus and conclusions	579
Description	581
Presentation of field data	582
Presentation of laboratory data	583
Hydrometric data	586
Discussion	588

LIST OF TABLES

Sc–1.—Cost estimates of remedial measures	580
Sc–2.—Surface water supplies	582
Sc–3.—Sources of pollution	582
Sc–4.—Industrial wastes	583
Sc–5.—Selected laboratory data	584
Sc–6.—Mean monthly summer flows	586
Sc–7.—Summary of laboratory data	582

LIST OF FIGURES

Sc–1. Map.—Sources of pollution	579
Sc–2. Chart.—Sources of pollution and selected laboratory data	582
Sc–3. Map.—Coliform results	584
Sc–4. Map.—Dissolved oxygen results	584
Sc–5. Map.—Biochemical oxygen demand results	584
Sc–6. Chart.—Summer low-flow frequency curve	587

Fig. Sc-1

Fig. Sc-1

SCIOTO BASIN

SOURCES OF POLLUTION

SCIOTO RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Scioto River Basin lies wholly in Ohio and comprises 6,510 square miles, including the Columbus metropolitan area and 10 other cities of from 5,000 to 30,000 population. Most of the basin is a highly developed agricultural area. The total population is about 740,000, of which 60 percent is urban. More than half of the population is in Franklin County (Columbus). Commendable progress has already been made toward pollution abatement. The present lack of practical methods of industrial waste treatment deters further progress in certain sections. Pollution control by increasing low-water flow offers possibilities in further improving conditions below Columbus.

CONCLUSIONS

(1) Most of the municipalities in the basin have developed underground water supplies which appear to be adequate. In general, pollution is not seriously affecting public water supplies. There is an increasing demand for cleaner streams for recreational use, particularly in the vicinity of Columbus.

(2) Sewage from a population of about 412,000 and industrial wastes with a sewered population equivalent of 426,000 are discharged to sewers. More than 95 percent of the sewage is treated. This treatment, plus treatment of industrial wastes in municipal treatment plants, reduces the total population equivalent of the wastes from 838,000 to 251,000.

(3) The laboratory results indicate that the Scioto River, Paint Creek, and sections of certain other tributaries south of the latitude of Columbus would, at the present time, be unfit as sources of water supply because of the high bacterial content. Above Columbus, except in local zones, the situation appears much better. As regards other uses, the situation is similar to the above but less critical.

(4) The Scioto River below Columbus carries considerable residual pollution from the city. The Columbus sewage treatment works is designed to maintain not less than 3 parts per million dissolved oxygen below Columbus at all times. This should be possible except at times of local rains. On account of these local rains oxygen conditions suitable to maintain fish life below Columbus require an estimated minimum flow of 75 cubic feet per second in addition to the sewage effluent from Columbus.

(5) As the 75 cubic feet per second minimum flow is required only for a matter of hours during local flash floods, a suggested solution involves use of limited storage as at Whittier Street Dam at Columbus. A draw-down of 0.85 feet, to which there appears to be no objection, would supply the necessary flow for 12 hours. A trifling capital cost

and no additional annual maintenance would be required in providing this flow.

(6) An estimated 22 cubic feet per second can be maintained by the proposed Delaware flood-control reservoir. This sustained flow would improve the stream to a limited extent and would replace water stored above Whittier following use during local flash floods.

(7) Several sections of tributary streams are grossly polluted. These are primarily local problems and the tributaries, with the exception of Paint Creek, are in suitable condition for all normal uses at their confluence with the Scioto.

(8) In view of the normal uses of the streams involved, refined treatment at certain sources of pollution would serve no purpose commensurate with the expenditure. In these instances, lesser treatment appears justified. A summary of comparative cost estimates of remedial measures from table Sc–1 follows:

Treatment	Capital cost	Annual charges
Existing	$12,890,000	$1,090,000
Suggested additional	1,300,000	180,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are—

Treatment	Capital cost	Annual charges
Primary, all places	$1,060,000	$150,000
Secondary, all places	1,700,000	225,000

TABLE Sc–1.—*Scioto River Basin: Estimated cost of existing and suggested minimum corrective measures for municipal and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	15	18	401,500	$12,890,000	$740,000	$350,000	$1,090,000
Suggested minimum correction:							
Sewage treatment plants	18	4	11,100	670,000	50,000	30,000	80,000
Required interceptors				260,000	10,000		10,000
Independent industrial waste correction				370,000	50,000	40,000	90,000
Total				1,300,000	110,000	70,000	180,000
Comparative cost:							
Primary treatment all waste				1,060,000	90,000	60,000	150,000
Secondary treatment all waste				1,700,000	140,000	85,000	225,000
As suggested				1,300,000	110,000	70,000	180,000

Description

The Scioto River Basin, 6,510 square miles in area, occupies the central and south central portion of Ohio. The river rises in the flat Till Plains near Marion and flows in a generally southerly direction to its confluence with the Ohio River at Portsmouth.

	Miles above mouth of Scioto River	Drainage area, square miles
Major tributaries:		
Salt Creek	51	553
Paint Creek	63	1,143
Deer Creek	85	408
Darby Creek	100	557
Little Walnut Creek	106	281
Big Walnut Creek	117	557
Olentangy River	132	536

	Populations			
	1910	1920	1930	1940
Larger cities:				
Columbus	181,511	237,031	290,564	306,087
Marion	18,232	27,891	31,084	30,817
Chillicothe	14,508	15,831	18,340	20,129
Total basin:				
Rural	274,691	268,896	269,434	291,761
Urban	272,845	341,841	420,506	447,790
Total	547,536	610,737	689,940	739,551

Industries.—While the Scioto River Basin is primarily an agricultural area, there are important industries, of which paper mills and canneries predominate. Other industries of lesser importance include meat, milk, metal, chemical, and rendering plants.

Water uses.—The city of Columbus secures its water supply from two reservoirs, total capacity 6,000,000,000 gallons, on the upper Scioto River. Flood-protection works, required primarily to reduce flood damages at Columbus and downstream, have been studied by local conservancy districts and the United States Engineer Department.

The Scioto River is not navigable and has no water-power developments. Columbus reservoirs are the only ones of appreciable size in the basin. Restricted recreational developments are present on the Scioto River below Columbus.

Presentation of Field Data

Figure Sc–1 shows the location and magnitude of all sources of organic pollution of consequence in the Scioto River Basin. Figure Sc–2 shows similar data and, in addition, location of water supply intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen and biochemical oxygen demand.

Public water supplies.—Forty-four public water supplies in the basin serve a total of about 480,000 people. Five of these supplies, as shown in table Sc–2, are from surface sources.

TABLE Sc-2.—*Scioto River Basin: Surface water supplies*

City	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls				
Columbus	Scioto River	138	LD	332,000	31.40
Delaware	Olentangy River	164	LD	10,000	.75
Westerville	Alum Creek	150	LD	3,500	.19
	Other surface supplies				
Sunbury	Impounded-Wells		LD	700	0.02
Marysville	Mill Creek-well		LD	4,000	.30
Total:					
Below sewer outfalls				345,500	32.34
Other				4,700	.32
Total, surface water supplies				350,200	32.66

[1] Miles above mouth of Scioto River.
[2] L=Lime-soda softened; D=Chlorinated.

Above the Columbus supply, most upstream pollution is treated. Storage provides an additional safeguard and the bacterial quality of the raw water is good.

Delaware suffered a serious water shortage in 1930 which might be overcome by supplementary low flow from the proposed Delaware Reservoir. There are no important sources of pollution immediately above Delaware and, in general, remote pollution of consequence receives treatment.

Sewerage.—Table Sc-3 shows data on the more important sources of sewage pollution. All but one of the towns of any size have sewage treatment facilities, although not all are adequately equipped or properly operated. More than 95 percent of the sewage is treated.

TABLE Sc-3.—*Scioto River Basin: Sources of significant pollution including industrial waste expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Stream	Miles above mouth of Scioto River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Chillicothe [1]	Scioto River	69.6	16,000	Primary	21,500	10,000
Federal Institution	do	72	3,600	do	3,600	3,200
Circleville [2]	do	99.8	4,900	do	90,700	76,100
Columbus [3]	do	132	300,000	Secondary	543,800	48,800
Kenton	do	209.2	5,100	None	5,200	5,200
Jackson	Salt Creek	75	4,500	Primary	5,600	4,000
Chillicothe [1]	Paint Creek	66.6		None	47,600	47,600
Frankfort	do	85	400	Primary	3,400	3,300
Hillsboro [4]	do	120	3,000	Secondary	3,100	500
Greenfield	do	111.2	3,400	Primary	5,700	3,800
Washington C. H.	do	130	7,000	do	10,300	5,900
Mt. Sterling	Deer Creek	118.8	800	Secondary	3,000	500
London	do	141	2,800	do	4,900	500

[1] Municipal waste to Scioto River; most industrial wastes to Paint Creek.
[2] Strawboard plant wastes.
[3] Treatment plant equipped with storm-water holding tanks.
[4] Recent treatment plant. Not in operation in 1939.

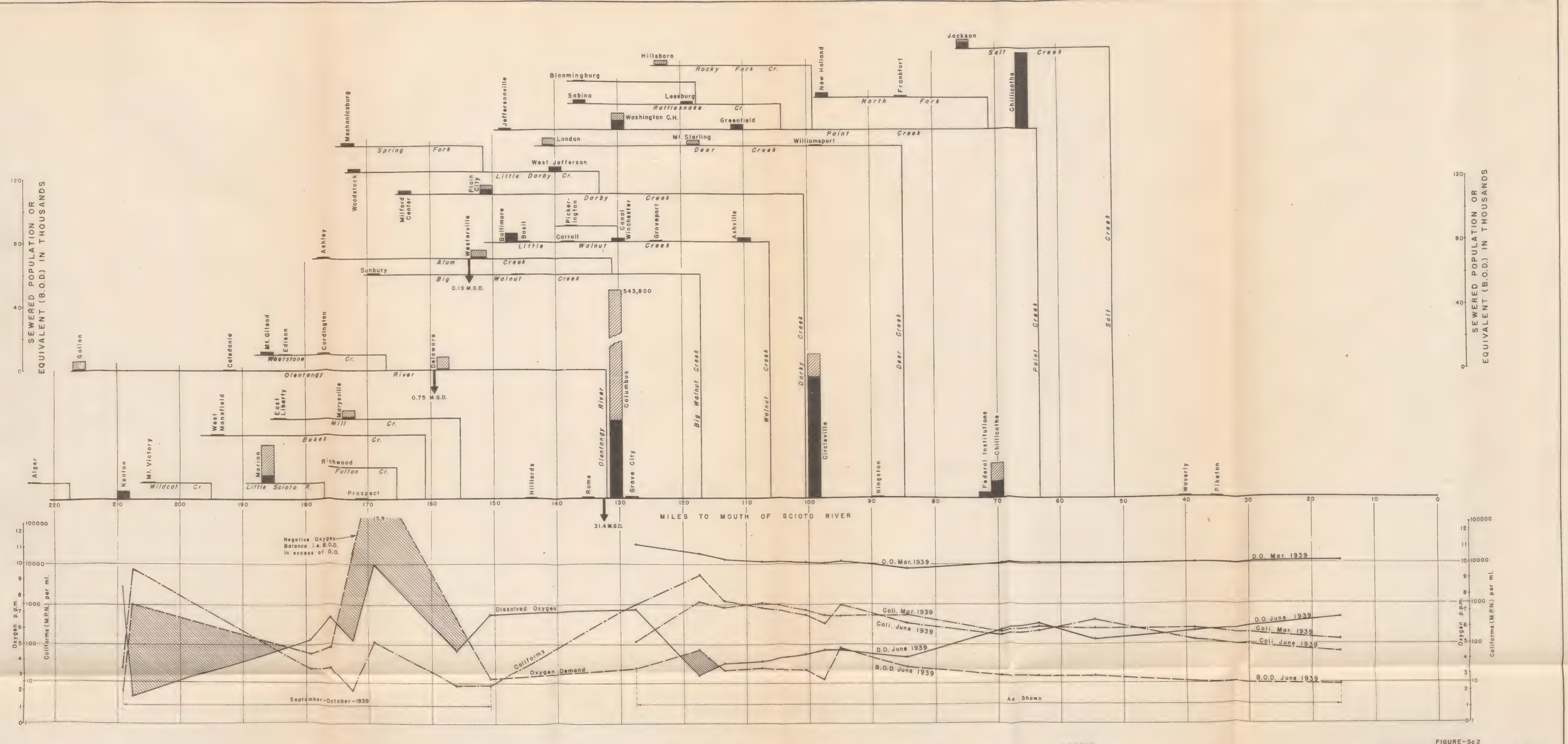


FIGURE-Sc2
SCIOTO RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY DATA
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE

 GPO-43 O-90035

TABLE Sc-3.—*Scioto River Basin: Sources of significant pollution including industrial waste expressed as sewered population equivalent (biochemical oxygen demand)*—Continued

Municipality	Stream	Miles above mouth of Scioto River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
West Jefferson	Darby Creek	140	500	Primary	3,000	2,800
Plain City	do	150.9	900	Secondary	5,600	3,200
Ashville	Little Walnut Creek	110	900	Primary	3,200	2,900
Canal Winchester	do	130	1,000	do	2,800	2,500
Baltimore	do	141	600	None	5,800	5,800
Westerville	Big Walnut Creek	152	3,000	Secondary	5,100	800
Delaware	Olentangy	158	8,000	do	8,300	900
Galion	do	216	6,000	do	6,000	900
Marysville	Mill Creek	173	4,200	do	5,400	1,000
Marion	Little Scioto	186	24,000	do	24,000	4,500
Small sources (35 towns).			12,000	Various	20,900	16,700
Total			412,600		838,500	251,400

Industrial waste.—Data on 48 industrial plants, wholly or partly unconnected to municipal treatment, are summarized on table Sc-4. However, by far the greatest industrial waste load is tributary to present municipal treatment. The Columbus and Circleville treatment plants both handle heavy industrial waste loads.

TABLE Sc-4.—*Scioto River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Canning	11	1	10	9	32,200
Chemical	4	0	4	3	
Meat	8	4	4	5	2,700
Metal	7	3	4	4	
Milk	7	3	4	4	700
Paper	3	0	3	3	39,200
Miscellaneous	8	2	6	5	2,500
Waste unconnected to municipal treatment	48	13	35	33	77,300
Waste connected to municipal treatment					348,600
Total industrial waste in basin					425,900

PRESENTATION OF LABORATORY DATA

Summaries of laboratory results for the Scioto River Basin are presented in table Sc-7. These data have been obtained in part from the operations of three laboratory units connected with the present survey, and in part from the results of a previous survey carried out by the Public Health Service along the main Scioto River below Columbus during the years 1937–39 (these results have been transcribed as monthly averages for the period January–July 1939). The data

for the upper Paint Creek watershed are based on continuing observations from the Cincinnati laboratory in 1939 and early 1940. For the remainder of the basin, the observations were made by mobile laboratories, covering shorter periods of time during September and October 1939.

Selected average monthly laboratory results at some of the principal points in the basin are tabulated with flows on sampling days and the minimum month on table Sc–5. In general, the results selected represent the lowest flow conditions during the sampling period.

TABLE Sc–5.—*Scioto River Basin: Selected laboratory data*

River Location	Scioto Above Kenton	Scioto Below Kenton	Scioto Upper end ressevoir	Scioto Above Columbus	Scioto Shadeville	Scioto South Bloomfield	Scioto Above Circleville
River miles above mouth of Scioto.	210	207	153	129.0	119.8	109.0	99.5
Period, 1939	October	October	October	June	June	June	June
Number of samples	3	3	1	17	17	17	17
Flow in cubic feet per second:							
Sampling days	2.2	2.2	----------	2,680	2,800	3,370	4,360
Minimum month	----------	----------	----------	----------	60	----------	----------
Water temperature, °C	15.5	16.8	20.5	23.7	23.1	24.0	23.6
Coliforms per milliliter	24	7,400	9	977	5,390	838	347
Dissolved oxygen, parts per million	8.6	1.7	6.9	7.1	3.0	3.9	4.6
Biochemical oxygen demand, 5-day, parts per million	2.0	7.5	2.6	3.4	4.6	3.3	2.7

River Location	Scioto Pennsylvania R. R. bridge	Scioto Kellenberger Bridge	Scioto Chillicothe	Scioto Kilgore Bridge	Scioto Higby	Scioto Waverly	Scioto Mouth Lucasville
River miles above mouth of Scioto.	95.5	86.2	70.0	64.3	55.7	38.7	15.0
Period, 1939	June	June	June	June	June	June	June
Number of samples	17	11	9	9	9	9	9
Flow in cubic feet per second:							
Sampling days	4,360	3,170	6,160	6,190	6,970	7,820	8,390
Minimum month	----------	----------	210	----------	263	----------	----------
Water temperature, °C	24.0	24.2	24.6	24.9	24.5	24.4	24.3
Coliforms per milliliter	948	372	198	244	429	136	63
Dissolved oxygen, parts per million	4.6	4.1	5.9	6.2	5.3	5.8	6.5
Biochemical oxygen demand, 5-day, parts per million	4.6	3.3	2.9	2.8	2.8	2.5	2.2

River Location	Little Scioto Above Marion	Little Scioto Below Marion	Olentangy Above Delaware	Olentangy Below Delaware	Little Walnut Above Baltimore	Little Walnut Below Baltimore	Rocky Fork Above Hillsboro
River miles above:							
Confluence with Scioto	9	9	28	24	36	33	57
Mouth of Scioto	186	180	160	156	142	139	120
Period, 1939	October	October	October	October	October	October	October
Number of samples	3	3	2	2	3	3	1
Flow in cubic feet per second:							
Sampling days	1.2	1.2	11.8	11.8	2.2	2.2	----------
Minimum month	.4	.4	.5	----------	0	0	0
Water temperature, °C	16.0	15.7	17.5	18.5	8.2	9.8	16.0
Coliforms per milliliter	26	38,300	12	26	18	2,730	24
Dissolved oxygen, parts per million	10.0	1.8	8.5	10.8	7.4	.5	7.8
Biochemical oxygen demand, 5-day, parts per million	3.7	13.5	3.0	2.8	2.0	87.7	1.2

Fig. Sc-3

Fig. Sc-3

SCIOTO BASIN

COLIFORM RESULTS

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

Fig. Sc-4
SCIOTO BASIN
DISSOLVED OXYGEN RESULTS.

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Sc-5

Fig. Sc-5

SCIOTO BASIN

BIOCHEMICAL OXYGEN DEMAND

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

TABLE Sc-5.—*Scioto River Basin: Selected laboratory data*—Continued

River	Rocky Fork	Paint Creek	Paint Creek	Paint Creek	Paint Creek	Paint Creek	Paint Creek
Location	Below Hillsboro	Above Washington Court House	No. 1 Below Washington Court House	Above Greenfield	Below Greenfield	Opposite Chillicothe	Mouth Chillicothe
River miles above:							
Confluence with Scioto	54	67	65	49	47	3.4	1.3
Mouth of Scioto	117	130	128	112	110	66.6	64.5
Period, 1939	October	September	September	October	October	July	July
Number of samples	1	1	1	1	1	5	5
Flow in cubic feet per second:							
Sampling days	----------	3.0	3.0	2.0	2.0	330	330
Minimum month	0	----------	----------	.5	.5	10.3	10.3
Water temperature, C°	17.5	20.0	19.0	17.0	17.0	23.0	24.0
Coliforms per milliliter	4,600	150,000	240,000	23	24,000	39	156
Dissolved oxygen, parts per million	4.2	.4	0	4.6	0	7.3	5.7
Biochemical oxygen demand, 5-day, parts per million	2.3	7.8	153	2.5	19.5	1.1	13.3

Figures Sc–3, Sc–4, and Sc–5 show, by spot-map symbols, the distribution of average monthly coliform results, dissolved oxygen content and 5-day oxygen demand, respectively, at the various sampling points throughout the basin, as based on the most unfavorable month of observations at each point. In general, the lower dissolved oxygen results coincided with lower river stages and high temperatures, whereas the higher coliform results tended to occur during months of high stages and low temperature. Along the main Scioto River, the dominant part played by the wastes of Columbus is apparent. In the tributary areas, the worst conditions were observed in the upper Paint Creek watershed, notably below Washington Court House. The section of the basin lying north of Columbus is shown to be relatively clear of heavy pollution, except in local stream zones immediately below the larger towns.

Figure Sc–2 shows the coliform bacteria and dissolved oxygen results as observed in the main Scioto River below Columbus during a typical high water month (March 1939) and a low-water month (June 1939). The low water dissolved oxygen content of the river below Columbus is shown to have followed a fairly typical "sag" curve, with a first minimum point at about 3 parts per million and a secondary minimum of 4 parts per million below Circleville. In Paint Creek below Washington Court House, the minimum reached zero oxygen for a distance of about 3 miles in October 1939. In contrast were the higher oxygen levels in both streams during the high-water months of March 1939 and 1940, though a tendency toward a delayed oxygen "sag" was shown under those conditions. In general, the observed numbers of coliform bacteria tended to follow a course directly opposite to that of the dissolved oxygen content, being highest at points near the minimum point of the oxygen sag curve.

The laboratory results for the basin as a whole indicate that the Scioto River, Paint Creek, and sections of certain other tributaries south of the latitude of Columbus would be unfit as sources of water supply unless extensive sewage chlorination measures were carried out over most of this area. Above Columbus, except in local zones, the situation appears much better in this respect. So far as other

stream uses are concerned, the situation indicated by the results is roughly parallel to that above described, except that conditions are shown to be somewhat less critical in portions of the area south of Columbus, as is indicated by comparing figures Sc–3 and Sc–4.

Hydrometric Data

Twenty-two stream gaging stations have been maintained on the Scioto River Basin for varying periods, 15 stations of which are in operation at the present time. Eight stations of importance from the pollution standpoint have been selected and the monthly mean summer flows for 3 years in which low summer flows have occurred are presented in table Sc–6.

Table Sc–6.—*Scioto River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Scioto	Scioto	Scioto	Scioto
Location	At Larue	At Columbus	At Chillicothe	At Higby
River miles above mouth of Scioto	192	132	69.6	55.7
Drainage area (square miles)	255	1,624	3,847	5,129
Period of record	1925–40	1921–40	1921–40	1930–40
Year	1930	1921	1930	1932
June ... cubic feet per second	36	283	470	1,980
July ... do	9	86	303	8,180
August ... do	6	96	[1] 214	561
September ... do	17	67	233	406
Year	1932	1924	1932	1934
June ... cubic feet per second	38	3,780	976	718
July ... do	23	874	1,710	868
August ... do	[1] 4.0	98	328	960
September ... do	7	66	252	387
Year	1934	1930	1934	1939
June ... cubic feet per second	41	178	435	5,450
July ... do	7	125	549	2,230
August ... do	12	82	565	822
September ... do	6	68	245	[1] 337

River	Little Scioto	Olentangy	Paint Creek	Paint Creek
Location	Near Marion	Near Delaware	Near Greenfield	Near Bourneville
River miles above:				
Confluence with Scioto	6	26	48	19.5
Mouth of Scioto	183	158	111.2	82.7
Drainage area (square miles)	81.2	387	251	808
Period of record	1924–40	1922–34	1927–36	1924–40
Year	1930	1930	1930	1930
June ... cubic feet per second	26	71	8	42
July ... do	3.6	10	.8	20
August ... do	1.2	1.8	[1] .5	[1] 11
September ... do	2.8	11	.7	27
Year	1933	1933	1932	1936
June ... cubic feet per second	10	26	223	70
July ... do	7	29	295	29
August ... do	2.1	3.5	6	30
September ... do	2.2	26	1.4	22
Year	1934	1934	1934	1939
June ... cubic feet per second	1.6	22	7	441
July ... do	1.2	6	38	249
August ... do	1.3	.9	33	128
September ... do	[1] .7	[1] .5	10	15

[1] Minimum month.

Fig. Sc-6

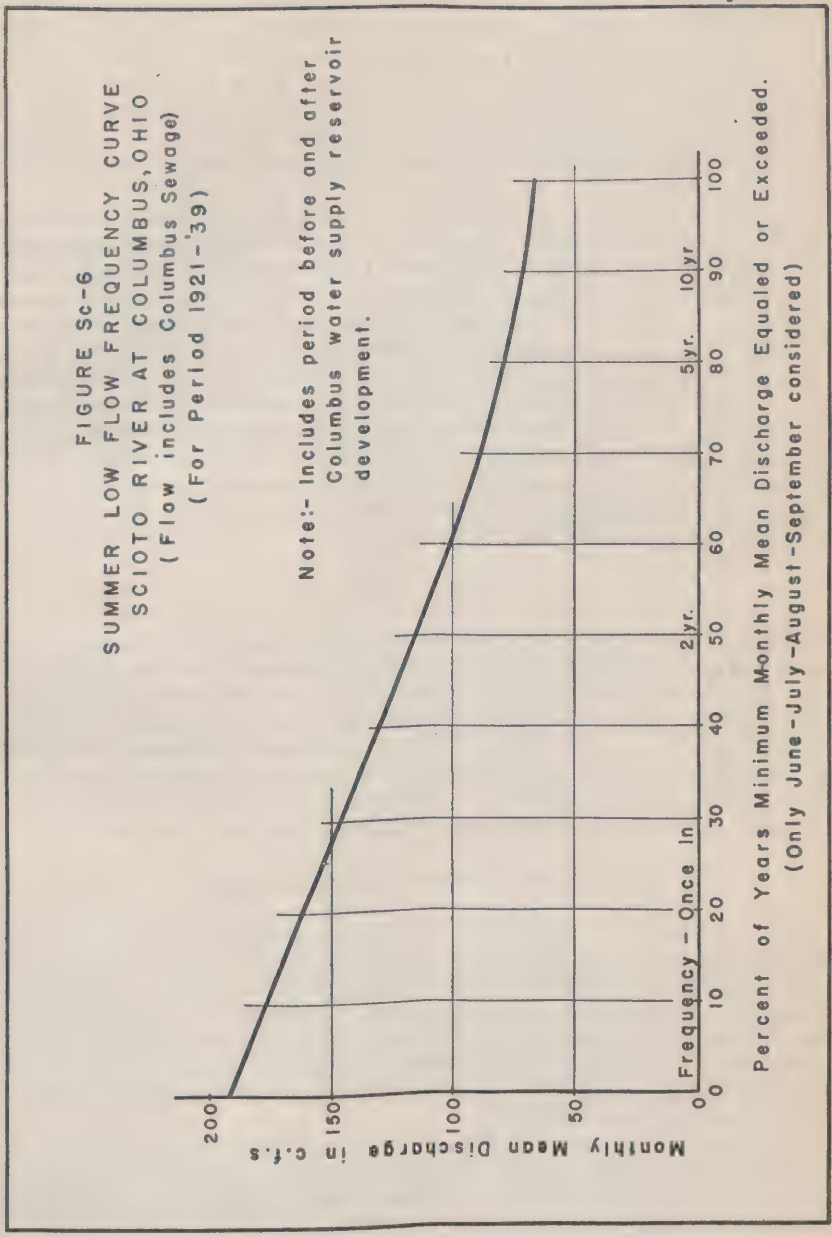


FIGURE Sc-6
SUMMER LOW FLOW FREQUENCY CURVE
SCIOTO RIVER AT COLUMBUS, OHIO
(Flow includes Columbus Sewage)
(For Period 1921-'39)
Note:- Includes period before and after Columbus water supply reservoir development.
Monthly Mean Discharge in c.f.s.
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
Frequency - Once In
2 yr.
5 yr.
10 yr.
Percent of Years Minimum Monthly Mean Discharge Equaled or Exceeded.
(Only June-July-August-September considered)

Figure Sc–6 presents a flow duration curve for the average monthly flows from June to September, inclusive, for the period from 1921 to 1939, for the Scioto River at Columbus below the Columbus sewer outfall so that the flows include the sewage flow (average 70 cubic feet per second). This curve indicates that average summer monthly flows of 190 cubic feet per second or less have occurred every year. Flows of 115 cubic feet per second may be expected every 2 years, 80 cubic feet per second every 5 years, and only the sewage flow of 71 cubic feet per second every 10 years. The minimum average monthly summer flow was 66 cubic feet per second. The low average monthly flow of 60 cubic feet per second shown on table Sc–5 occurred during the winter.

Low-flow regulation.—The United States Engineer Department has determined three reservoir sites to be most nearly satisfactory for flood control and allied purposes—Delaware, Paint Creek, and Rocky Fork. The Delaware Reservoir on Olentangy River above Columbus could be of value for flood control, water supply for the city of Delaware, and for pollution abatement, and would be capable of maintaining a minimum flow of 22 cubic feet per second at the dam site. Under present plans, the Paint Creek and Rocky Fork Reservoirs are to be used solely for flood control. Seasonal low-flow control operations, if conducted at the Paint Creek and Rocky Fork Reservoirs in conjunction with flood-control operations, would result in minimum discharges of 51 cubic feet per second and 13 cubic feet per second, respectively, at the dam sites.

Discussion

Pollution problems of more than local significance exist on the main Scioto River below Columbus, on Paint Creek from Washington Courthouse to the confluence with the Scioto River at Chillicothe, and below Kenton on the upper Scioto, the only community of appreciable size without treatment facilities. Minor pollution problems, of local significance only, exist at various points below a number of moderate sized and small municipalities. Corrective measures at these points are included in the cost estimates, but discussion has been omitted.

MAIN SCIOTO RIVER BELOW COLUMBUS

The 132 miles of Scioto River between its mouth and the Olentangy River at Columbus receives wastes with a population equivalent of about 111,100. A large part of this is a residual pollution following treatment. Columbus, Circleville, and Chillicothe contribute more than 95 percent of this pollution load. With the exception of Paint Creek, the six tributaries of appreciable size entering this section of the main stream are generally less polluted at their mouths than the main stream at the confluence.

Columbus.—The recently completed activated sludge plant at Columbus treats practically all of the sewage and industrial wastes from the city and its suburbs. This plant, designed to maintain a minimum of 3 parts per million of dissolved oxygen in the river below Columbus, provides also for the treatment of storm water by diversion to storage tanks until treatment is possible during a subsequent period of lower sewage flow. Such a refinement in pollution

abatement is rarely applied in the United States, and Columbus has the only large installation of its kind in the Ohio Basin.

Despite this refinement, surface wash is of marked consequence. During the critical season, local showers may cause pollution from surface wash and overflow of storm water from certain combined sewers with little corresponding increase in dilution flow from above Columbus. The oxygen demand of this flush water may be sufficient, according to data of the Ohio Department of Health, to reduce the dissolved oxygen in the stream below the critical point.

During January 15, 1937, to August 15, 1939, the Scioto River below Columbus was studied by the Stream Pollution Investigations Station of the United States Public Health Service, to determine the effects on the stream of the completed sewage-treatment plant at Columbus. Because of delays in placing the plant in full operation, this investigation was suspended and only limited data are available to indicate the effectiveness of treatment in improving river water quality during a critical low-flow period.

Stream discharge below Columbus includes the city sewage flow which amounts at present to about 70 cubic feet per second. Discharge records are available for the years 1921 to 1939 during which the city built a large water supply reservoir above Columbus which also influences the low flow of the Scioto. The flow data presented, therefore, are not strictly applicable to present conditions. They do indicate, however, that the treated sewage of Columbus is at times the only flow in the stream and that in most years there is at least 1 month when the dilution available is less than one volume. At Chillicothe and Higby the flow of the stream is much greater.

The selected laboratory results presented indicate conditions before the Columbus plant was in full operation and during a period of rather high flow. The minimum flow above Columbus during period of observations was 2,800 cubic feet per second, whereas in September 1939 the flow was only 86 cubic feet per second. The results show that the stream was rather heavily polluted in spite of the high flows.

The city of Columbus has certainly taken every reasonable step possible toward the correction of its pollution problem. With initial operating difficulties overcome, it is probable that the accomplishment for which the works were designed, namely, an absolute minimum of 3 parts per million dissolved oxygen in the Scioto River below the plant, will be attained a very high percentage of the time. Possible exceptions will be at times of local rains.

Largely because of the effect of local rains, oxygen conditions below Columbus suitable to maintain fish life are possible only with an estimated minimum flow, in addition to the sewage effluent of 75 cubic feet per second. An estimated 22 cubic feet per second can be maintained by the proposed Delaware flood-control reservoir on the Olentangy River above Columbus, but this is not sufficient to accomplish the desired result.

As the problem is one resulting from local rain, supplemental low flow is required for only a short period, possibly a matter of hours, but should be available on very short notice. This suggests less storage located near Columbus. The Whittier Street Dam forming the pool opposite Columbus might be used for this purpose. In case the storage is used in a matter of hours at the time of a local rain, the water could be replaced over a period of several days, if necessary,

from the available 22 cubic feet per second from the proposed Delaware Reservoir.

The present construction of the Whittier Street Dam includes four 4-foot square outlets through the dam. Supplemental flow of 75 cubic feet per second for a period of 12 hours may be obtained from the pool above the Whittier Street Dam by a draw-down of about 0.85 feet. There have been no great objections to past temporary lowering of this pool. A light lifting device for removing the stop logs will be necessary at an estimated cost of $50.

Circleville.—Circleville has recently completed a chemical precipitation treatment plant that can, if desired, be divided into two parts, one to treat wastes from a large strawboard plant and the other to treat city sewage and all other industrial wastes. The Circleville plant was not in full operation during the period from January to July 1939 when laboratory examinations of stream samples were being made. Principal pollution is from the strawboard wastes. Treatment of these wastes by chemical precipitation removes practically all of the settleable solids and a portion of the finer suspended solids. Elimination of shoals and sludge banks, therefore, may be expected. Oxygen demand reduction, however, is of minor consequence. Methods of correcting strawboard waste pollution are now being studied at several places. However, at the present time, the Circleville plant represents the only installation where even partial treatment is actually practiced. Lagooning has been temporarily effective at certain plants in the past.

Further treatment of sewage and wastes at Circleville appears desirable. However, secondary treatment of sewage would have but a very minor effect and no practical method for additional treatment has been developed for strawboard wastes. Further study of the strawboard waste problem appears indicated.

Despite limited treatment of waste and sewage at Circleville, quality of water below the city, because of higher flow, is superior to that below Columbus.

Chillicothe.—Chillicothe has a primary treatment plant for all of its sewage. Certain industrial wastes, principally from paper plants, are discharged to Paint Creek. In the paper mills, recirculation is practiced to a limited extent and save-alls have been installed, both desirable pollution correction measures. The Federal Reformatory just north of Chillicothe has a primary treatment plant.

The sewage treatment plant effluents from Chillicothe and the Federal Reformatory above the city, plus industrial wastes which enter through Paint Creek, have some slight deleterious effect on the Scioto River. However, here again, because of higher flow, the quality of Scioto River water below the city is superior to that below Columbus. The slight effect on the Scioto as shown by the laboratory results would not justify further treatment.

Industrial pollution in Paint Creek between Chillicothe and the confluence with the Scioto River creates a serious condition. This pollution could be largely and justifiably corrected by discharging all but the paper mill wastes to public sewers for treatment in the municipal plant. The paper mill wastes are of such a volume that separate treatment is indicated. There are possibilities of further reduction of the paper mill wastes by recovery of byproducts and reuse of water. Remaining wastes are capable of treatment by chemical precipitation.

PAINT CREEK

Wastes with a population equivalent of 18,900 enter Paint Creek and its tributaries above Chillicothe. The worst stream conditions, as shown by the laboratory results, are in the vicinity of Washington Court House and Greenfield, where zero oxygen conditions prevailed.

Paint Creek and its tributaries are important streams in a thriving agricultural district. Despite their condition, these streams are used for swimming and other recreational purposes. There appears ample justification for secondary treatment of sewage and wastes and this fact is generally recognized. Present primary treatment plants were installed as temporary expedients to be supplemented within a reasonable time with secondary treatment facilities.

KENTON

This is the only urban community in the Scioto River Basin without sewage treatment facilities. Its location above Columbus water supply reservoirs makes the provision of such facilities of more than local importance. Gross nuisance conditions prevail below the sewer outfalls during the summer months and laboratory results during September and October 1939 showed only 1.7 parts per million of dissolved oxygen in the Scioto below town. Complete recovery was not apparent even 30 miles downstream. Secondary treatment appears justified for improvement of local conditions and protection of Columbus' water supply.

MISCELLANEOUS POLLUTION

A number of other sources of wastes on the Scioto River and its tributaries cause serious pollution of primarily local significance. Remedial measures appear justified at Jackson, West Jefferson, Ashville, and Baltimore. Some industrial wastes correction is needed at most of these places, particularly along Little Walnut Creek.

Cost estimates for remedial measures for pollution abatement suggested, as justified by the stream uses, are summarized in table Sc–1.

90035—44—pt. 2——29

TABLE Sc-7.—*Scioto River Basin: Ohio River pollution survey laboratory data—Summary of averages*

Sampling point	Mileage from mouth	Period	Number of samples	Average discharge cubic feet per second	Temperature °C	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per mile	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Scioto River, above Kenton, Ohio	Sc 209.5	September and October 1939.	3	2	15.5	8.6	2.0	24	8.0	47	236	225
Scioto River, below Kenton, Ohio	Sc 208	do	3	2	16.8	1.7	7.5	7,410	7.7	8	315	369
Scioto River, above Greencamp, Ohio.	Sc 179.5	do	1	----------	17.0	5.3	4.4	23	7.9	29	231	----------
Little Scioto River, above Marion, Ohio.	ScLs 184.5	do	3	1	16.0	10.0	3.7	26	8.3	18	143	150
Little Scioto River, below Marion, Ohio.	ScLs 179	do	3	1	15.7	1.8	13.5	38,600	7.5	25	274	185
Scioto River, 1 mile below Greencamp, Ohio.	Sc 175.5	do	1		17.0	6.7	4.7	23	7.9	.8	258	----------
Scioto River, above Prospect, Ohio	Sc 172	do	1	----------	17.0	5.2	11.3	7	8.0	32	200	----------
Scioto River, 1 mile below Prospect, Ohio.	Sc 170	do	1	----------	18.0	10.4	15.9	110	8.6	15	191	----------
Scioto River, above mouth Mill Creek, Bellpoint, Ohio.	Sc 156	do	1	----------	19.5	4.6	6.6	9	7.8	56	233	----------
Mill Creek, above Marysville, Ohio	ScM 172	do	4	----------	15.1	7.3	3.0	6	7.9	40	192	129
Mill Creek, below Marysville, Ohio.	ScM 166	do	4	----------	17.8	4.3	7.2	7,250	7.7	23	227	191
Mill Creek, at mouth	ScM 156	do	1	----------	19.0	6.5	.8	15	7.7	15	214	----------
Scioto River, upper end Columbus Reservoir.	Sc 151.5	do	1	----------	20.5	6.9	2.6	9	7.5	45	190	----------
Olentangy River, 1 mile above Galion, Ohio.	ScO 213	do	2	1	11.5	7.8	2.7	15	7.6	43	97	125
Olentangy River, 1½ miles below Galion, Ohio.	ScO 211	do	2	1	10.3	6.5	2.8	59	7.8	14	199	136
Olentangy River, above Waldo, Ohio	ScO 174	do	1	(1)	18.5	7.0	1.9	9	7.7	15	235	----------
Olentangy River, below Waldo, Ohio	ScO 173	do	1	(1)	19.0	8.6	1.8	43	7.8	13	288	----------
Whetstone Creek, above Mt. Gilead, Ohio.	ScOW 187	do	3	(1)	15.3	8.8	1.9	16	7.8	10	250	----------
Whetstone Creek, below Mt. Gilead, Ohio.	ScOW 185	do	2	(1)	14.5	9.3	6.7	235	8.1	18	231	----------
Olentangy River, above Delaware, Ohio.	ScO 159	do	2	12	17.5	8.5	3.0	12	8.0	16	183	137
Olentangy River, Central St. Bridge, Delaware, Ohio.	ScO 158	do	1	8	13.5	9.0	1.7	24	7.9	15	204	----------
Olentangy River, Winter St. Bridge, Delaware, Ohio.	ScO 158	do	1	8	14.5	9.5	1.6	9	8.0	15	208	----------
Olentangy River, Williams St. Bridge, Delaware, Ohio.	ScO 158	do	1	8	15.0	9.3	1.4	24	8.0	15	201	----------

Olentangy River, below Delaware, Ohio.	ScO 157	do	2	12	18.5	10.8	2.8	26	8.6	5	202	153
Scioto River, station 127.5, Columbus, Ohio.	Sc 129.3	January 1939	16	646	3.4	12.7	1.7	82	8.1		179	
Do	do	February 1939	16	3,055	3.6	13.5	2.4	248	7.7		116	
Do	do	March 1939	17	5,088	6.3	12.6	2.1	115	7.6		109	
Do	do	April 1939	17	3,484	9.5	11.6	1.8	45	7.7		124	
Do	do	May 1939	12	392	19.0	9.1	2.0	52	8.2		160	
Do	do	June 1939	17	2,680	23.7	7.1	3.4	977	7.9		146	
Do	do	July 1939	12	931	23.9	7.3	1.6	91	7.8		146	
Scioto River, station 117.5, Shadeville, Ohio.	Sc 119.8	January 1939	16	677	4.3	5.4	16.3	8,160	7.5		200	
Do	do	February 1939	16	3,194	3.8	12.5	5.3	1,620	7.6		131	
Do	do	March 1939	17	5,326	6.4	11.3	3.9	1,240	7.6		119	
Do	do	April 1939	17	3,646	9.4	10.0	4.0	1,490	7.7		136	
Do	do	May 1939	12	410	18.4	2.7	4.6	2,140	7.6		192	
Do	do	June 1939	17	2,804	23.1	3.0	4.6	5,390	7.6		162	
Do	do	July 1939	12	974	23.7	4.2	3.1	2,200	7.6		154	
Alum Creek, above Westerville, Ohio.	ScBwA 152	September and October 1939.	1	3	12.0	7.4	1.7	9	7.9	10	223	190
Alum Creek, below Westerville, Ohio.	ScBwA 151	do	1	3	11.0	8.5	3.5	23	8.1	3	176	176
Big Walnut Creek, at mouth	ScBw 117	January 1939	4		3.2	12.3	.9	6	7.8		198	
Do	do	February 1939	4		3.4	12.6	2.7	90	7.6		112	
Do	do	March 1939	5		6.4	11.6	1.5	119	7.6		128	
Do	do	April 1939	4		10.2	10.1	1.6	77	7.6		126	
Do	do	May 1939	1		12.5	10.1	.9	4	7.9		194	
Scioto River, station 113.5, Commercial Point, Ohio.	Sc 115	January 1939	16	845	5.1	6.7	8.6	2,350	7.6		201	
Do	do	February 1939	16	4,645	4.0	12.4	4.8	756	7.6		127	
Do	do	March 1939	17	6,098	6.8	10.9	4.0	885	7.6		123	
Do	do	April 1939	17	5,478	9.8	9.9	3.5	1,020	7.6		132	
Do	do	May 1939	12	663	19.7	4.2	4.7	659	7.6		201	
Do	do	June 1939	17	3,367	24.0	3.8	3.2	1,320	7.6		164	
Do	do	July 1939	12	1,290	24.3	5.0	2.8	733	7.6		161	
Scioto River, station 107.5, South Bloomfield, Ohio.	Sc 109	January 1939	16	858	5.2	5.9	7.3	375	7.6		203	
Do	do	February 1939	16	4,746	3.9	12.2	5.1	620	7.6		129	
Do	do	March 1939	17	6,159	6.9	10.8	3.6	1,020	7.6		128	
Do	do	April 1939	17	5,592	9.8	9.7	3.6	1,230	7.6		133	
Do	do	May 1939	12	680	19.8	4.5	4.2	501	7.6		201	
Do	do	June 1939	17	3,408	24.1	3.9	3.3	838	7.6		164	
Do	do	July 1939	12	1,311	24.2	5.1	2.5	663	7.6		165	
Little Walnut Creek, 1 mile above Baltimore.	ScW 147	October and November 1939.	3	2	8.2	7.4	2.0	18	7.6	8	238	375
Little Walnut Creek, 1 mile below Paw Paw Creek, Baltimore.	ScW 145	do	3	2	9.8	.5	87.7	2,730	7.4	67	345	389
Little Walnut Creek, 4½ miles below Paw Paw Creek, below Basil, Ohio.	ScW 141.5	do	2		7.3	1.5	17.4	483	7.3	22	333	383

[1] Less than 1.

TABLE Sc-7.—*Scioto River Basin: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from mouth	Period	Number of samples	Average discharge cubic feet per second	Temperature °C	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per mile	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Little Walnut Creek, ½ mile northwest Lockville, Ohio.	ScW 134	October and November 1939.	2	----------	7.5	5.1	4.4	9	7.5	13	283	377
Sycamore Creek, 1¼ miles above Pickerington, Ohio.	ScWSy 139	do	3	2	11.3	9.3	1.6	6	7.7	34	238	610
Sycamore Creek, ¾ mile below Pickerington, Ohio.	ScWSy 137	do	3	2	12.0	6.8	8.3	182	7.6	29	223	758
Little Walnut Creek, ½ mile above Canal, Winchester, Ohio.	ScW 130.5	do	1	9	14.0	8.7	3.3	4	7.9	18	307	----------
Little Walnut Creek, ⅛ mile above Canal, Winchester, Ohio.	ScW 130.1	do	2	20	10.0	10.0	2.8	8	7.6	28	259	630
Little Walnut Creek, ½ mile below Canal, Winchester, Ohio.	ScW 129.5	do	3	17	11.3	9.1	3.2	283	7.6	25	285	626
Little Walnut Creek, 1 mile above Ashville, Ohio.	ScW 110.5	do	3	40	10.2	7.4	2.1	5	7.7	30	270	439
Little Walnut Creek, 1 mile below Ashville, Ohio.	ScW 109	do	3	40	10.5	7.0	2.9	101	7.6	29	280	443
Scioto River, station 100.5, Red Bridge.	Sc 101.8	January 1939	16	957	4.5	8.1	4.0	219	7.6	----------	206	----------
Do	do	February 1939	16	5,534	4.1	11.9	4.3	820	7.6	----------	134	----------
Do	do	March 1939	17	6,662	6.9	10.7	3.4	720	7.6	----------	133	----------
Do	do	April 1939	17	6,583	9.9	9.6	3.4	498	7.6	----------	137	----------
Do	do	May 1939	12	816	19.5	5.9	3.2	164	7.7	----------	208	----------
Do	do	June 1939	17	3,744	24.0	4.4	3.2	592	7.6	----------	165	----------
Do	do	July 1939	12	1,492	24.3	5.4	2.1	463	7.7	----------	169	----------
Big Darby Creek, above Plain City, Ohio.	ScD 151	September and October 1939.	2	3	12.0	8.1	2.8	35	8.1	41	244	127
Big Darby Creek, below Plain City, Ohio.	ScD 150	do	2	3	11.8	6.5	3.1	142	7.9	9	250	133
Little Darby Creek, above Mechanicsburg, Ohio.	ScD1 174	September and October 1939.	2	(1)	11.5	9.2	1.5	31	7.9	10	49	151
Little Darby Creek, below Mechanicsburg, Ohio.	ScD1 172	do	2	(1)	11.8	9.8	1.8	277	7.9	13	53	153
Darby Creek, at mouth	ScD 100.5	January 1939	4	----------	3.1	13.1	1.3	31	8.1	----------	254	----------
Do	do	February 1939	4	----------	3.5	12.3	1.3	63	7.8	----------	202	----------
Do	do	March 1939	5	----------	6.8	11.9	1.3	75	7.9	----------	202	----------
Do	do	April 1939	4	----------	10.4	10.6	1.3	51	8.0	----------	205	----------
Do	do	May 1939	1	----------	13.0	10.8	1.0	4	8.3	----------	244	----------
Scioto River, station 99.5, Circleville, Ohio.	Sc 99.5	January 1939	16	1,133	3.8	9.1	3.0	215	7.7	----------	218	----------
Do	do	February 1939	16	6,962	3.4	12.2	2.6	504	7.6	----------	141	----------

Do	do	March 1939	17	7,558	6.1	10.6	3.6	522	7.6		140	
Do	do	April 1939	17	8,362	9.4	9.7	2.6	467	7.7		140	
Do	do	May 1939	12	1,058	18.7	6.3	1.9	158	7.7		216	
Do	do	June 1939	17	4,360	23.6	4.6	2.7	347	7.6		172	
Do	do	July 1939	12	1,811	24.1	5.8	7.6	297	7.7		177	
Scioto River, station 95.5, Pennsylvania R. R. Bridge.	Sc 95.5	January 1939	16	1,134	4.7	9.1	6.9	632	7.7		218	
Do	do	February 1939	16	6,968	4.2	11.9	3.9	1,480	7.6		147	
Do	do	March 1939	17	7,562	7.4	10.7	4.4	442	7.6		147	
Do	do	April 1939	17	8,372	10.0	9.7	3.8	527	7.7		149	
Do	do	May 1939	12	1,060	19.8	6.2	5.7	272	7.7		221	
Do	do	June 1939	17	4,362	24.0	4.6	4.6	948	7.7		178	
Do	do	July 1939	12	1,812	24.6	5.3	4.3	794	7.7		184	
Scioto River, station 84.5, Kellenberger's Bridge.	Sc 86.2	January 1939	12	1,457	4.7	8.4	4.4	241	7.7		218	
Do	do	February 1939	8	7,789	5.1	11.5	2.9	408	7.6		147	
Do	do	March 1939	8	8,299	7.4	10.1	3.8	528	7.7		148	
Do	do	April 1939	7	6,863	10.4	9.7	3.2	269	7.7		154	
Do	do	May 1939	7	1,183	19.2	5.9	4.3	121	7.7		228	
Do	do	June 1939	11	3,174	24.2	4.1	3.3	372	7.7		186	
Do	do	July 1939	7	1,513	24.2	4.5	3.0	331	7.7		186	
Oak Creek, above London, Ohio	ScDO 142	September 1939	1	1	20.0	4.5	6.3	150	8.0			
Do	do	October 1939	1	(1)	17.5	8.5	2.4	4	7.9			
Do	do	November 1939	1	1	5.0	10.9	1.8	46	7.8			
Do	do	December 1939	1		3.0	12.3	1.8	(1)	7.8			
Do	do	January 1940	1		0	13.3	1.3	46				
Oak Creek, below London, Ohio	ScDO 140	September 1939	1	1	20.0	6.2	2.9	430	7.9			
Do	do	October 1939	1	(1)	17.5	7.6	2.9	36	7.9			
Do	do	November 1939	1	1	4.5	11.3	1.7	93	7.7			
Do	do	December 1939	1		1.0	12.3	1.3	43	7.8			
Do	do	January 1940	1		0	12.1	3.4	1,100				
Deer Creek, above Mount Sterling, Ohio.	ScDe 119	September 1939	1	9	22.5	8.4	1.6	24	8.1			
Do	do	October 1939	1	6	18.5	9.2	1.9	8	8.2			
Do	do	November 1939	1	11	6.0	11.0	1.0	15	8.0			
Do	do	December 1939	1		2.0	12.8	1.1	9	7.9			
Do	do	January 1940	1		1.0	13.1	5.2	460				
Deer Creek, below Mount Sterling, Ohio.	ScDe 116	September 1939	1	9	22.5	8.1	1.9	93	8.1			
Do	do	October 1939	1	6	19.0	8.8	2.2	4	8.2			
Do	do	November 1939	1	11	6.0	11.2	1.0	23	7.9			
Deer Creek, below Mount Sterling, Ohio.	do	December 1939	1		2.0	12.6	0.8	4	8.0			
Do	do	January 1940	2		0	12.2	3.6	143	7.5			
Deer Creek, at mouth	ScDe 84.8	January 1939	4		3.2	13.0	1.0	3	8.1		251	
Do	do	February 1939	4		4.0	11.7	1.3	58	7.8		188	
Do	do	March 1939	5		6.6	11.8	1.2	125	7.9		212	
Do	do	April 1939	4		9.4	10.5	1.5	42	8.0		206	
Do	do	May 1939	1		10.0	10.3	1.1	4	8.3		242	

[1] Less than 1

TABLE SC.-7.—*Scioto River Basin: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from mouth	Period	Number of samples	Average discharge cubic feet per second	Temperature °C	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per mile	pH	Turbidity, parts per million	Alkalinity parts per million	Hardness parts per million
Scioto River, Chillicothe, Ohio	Sc 70	January 1939	9	2,770	4.9	9.7	4.7	1,350	7.7		206	
Do	do	February 1939	7	12,920	3.9	11.9	3.7	756	7.6		124	
Do	do	March 1939	9	9,544	7.8	10.6	3.4	237	7.7		148	
Do	do	April 1939	8	10,174	11.2	9.5	2.8	216	7.7		153	
Do	do	May 1939	5	1,431	17.9	8.5	3.8	58	7.8		219	
Do	do	June 1939	9	6,163	24.6	5.9	2.9	198	7.7		180	
Do	do	July 1939	5	2,237	23.8	6.3	2.8	241	7.8		194	
Scioto River, Kilgore Bridge	Sc 64.3	January 1939	9	2,784	5.4	10.1	4.4	202	7.7		214	
Do	do	February 1939	7	12,986	4.1	11.9	3.9	510	7.6		135	
Do	do	March 1939	9	9,580	7.9	10.5	3.2	323	7.7		152	
Do	do	April 1939	8	10,220	11.2	9.5	2.4	224	7.7		158	
Do	do	May 1939	5	1,436	17.7	9.2	3.6	96	8.0		229	
Do	do	June 1939	9	6,192	24.9	6.2	2.8	264	7.8		182	
Do	do	July 1939	5	2,247	23.8	6.5	2.4	295	7.8		199	
Paint Creek, above Washington Court House.	ScP 132	July 1939	1		26.0	7.3	1.4	150				
Do	do	September 1939	1		20.0	.4	7.8	150,000	7.6			
Do	do	October 1939	2		11.3	3.6	3.3	295	7.6			
Do	do	December 1939	1		6.0	10.2	2.8	36	7.8			
Do	do	January 1940	2		0	7.7	1.5	14	7.5			
Do	do	February 1940	5		1.9	11.5	1.8	88	7.7			
Do	do	March 1940	4		4.8	12.3	1.0	205	7.8			
Do	do	April 1940	1		15.0	9.4	3.0	9	8.0			
Paint Creek, point No. 1, below Washington Court House, Ohio.	ScP 127.5	July 1939	1		25.0	0	19.2	24,000				
Do	do	September 1939	1	3	19.0	0	152.6	240,000	7.2			
Do	do	October 1939	2	4	11.8	0	278.0	670,000	7.1			
Do	do	December 1939	1		7.0	0	129.0	91,000	7.3			
Do	do	January 1940	1		1.0	0	112.5	75,000				
Paint Creek, point No. 2, below Washington Court House, Ohio.	ScP 126	September 1939	1		18.0	0	71.4	110,000	7.2			
Do	do	October 1939	2		9.0	0	180.0	160,000	7.5			
Do	do	December 1939	1		4.5	0	165.0	23,000	7.4			
Do	do	January 1940	2		0	3.9	74.5	121,000	7.5			
Do	do	February 1940	5		2.6	10.6	10.9	1,100	7.7			
Do	do	March 1940	4		5.8	11.7	4.6	209	7.8			
Do	do	April 1940	1		14.5	8.2	2.5	150	8.0			
Paint Creek, point No. 3, below Washington Court House, Ohio.	ScP 124.5	September 1939	1		20.0	0	81.2	46,000	7.6			
Do	do	October 1939	2		10.3	0	124.0	33,500	7.4			
Do	do	December 1939	1		4.5	0	172.5	4,300	7.4			
Do	do	January 1940	1		0	0	135.5	46,000				

Paint Creek, point No. 4, below Washington Court House, Ohio.	ScP 123.5	September 1939	2		20.3	10.4	9.0	23	8.2			
Do	do	October 1939	2		10.8	2.4	63.3	55,000	7.8			
Do	do	December 1939	1		5.0	7.4	14.7	3,600	7.8			
Do	do	January 1940	1		0	0	87.0	4,300				
Paint Creek, point No. 5, below Washington Court House, Ohio.	ScP 122.5	September 1939	1		21.0	6.1	4.3	4	8.1			
Do	do	October 1939	2		12.0	2.1	97.5	1,200	7.9			
Do	do	December 1939	1		5.0	8.0	5.6	360	7.9			
Do	do	January 1940	2		0	1.5	52.7	1,900	7.5			
Do	do	February 1940	5		1.2	9.5	7.1	2,470	7.6			
Do	do	March 1940	4		4.8	11.3	2.0	268	7.7			
Do	do	April 1940	1		14.0	7.1	2.6	240	7.8			
Paint Creek, point No. 6, below Washington Court House, Ohio.	ScP 121.5	September 1939	1		22.5	7.5	2.4	2	7.9			
Sugar Creek, above Jeffersonville, Ohio.	ScPS 148	August 1939	1	1	24.5	3.4	2.8	240				
Do	do	October 1939	1	1	15.5	4.4	13.5	150	8.0			
Sugar Creek, below Jeffersonville, Ohio.	ScPS 147	August 1939	1	1	25.5	5.4	7.9	460				
Do	do	October 1939	1	1	14.5	5.6	8.1	930	8.0			
Do	do	November 1939	1	1	7.0	6.5	6.5	230	7.5			
Do	do	December 1939	1	1	2.5	11.1	7.2	93	7.8			
Do	do	January 1940	1		0	1.1	38.0	93	7.6			
Paint Creek, above Greenfield, Ohio	ScP 112.0	September 1939	1	4	24.0	4.8	2.1	24	7.9			
Do	do	October 1939	1	2	17.0	4.6	2.5	23	7.6			
Do	do	November 1939	1	9	5.5	9.8	1.7	9	7.8			
Do	do	December 1939	1		7.0	10.6	2.4	2	8.0			
Do	do	January 1940	1		0	9.4	2.5	36	7.5			
Paint Creek, above Greenfield, Ohio	ScP 112.0	February 1940	5		2.8	12.2	2.4	213	7.7			
Do	do	March 1940	4		6.3	12.4	1.1	79	7.9			
Do	do	April 1940	1		15.0	11.2	1.4	4	8.1			
Paint Creek, below Greenfield, Ohio	ScP 109.4	September 1939	1		22.0	6.4	6.0	240	7.8			
Do	do	October 1939	1		17.0	0	19.5	24,000	7.6			
Do	do	November 1939	1		7.5	1.4	27.9	9,300	7.6			
Do	do	December 1939	1		8.5	6.3	6.8	1,500	7.8			
Do	do	January 1940	1		0	12.5	3.2	2,400	7.7			
Do	do	February 1940	5		2.5	13.1	3.2	1,020	7.8			
Do	do	March 1940	4		5.9	12.7	1.7	503	7.9			
Do	do	April 1940	1		14.5	11.4	2.8	430	8.2			
Wilson Creek, above Sabina, Ohio	ScPRW 137	July 1939	1	7	26.5	6.5	1.7	43				
Do	do	September 1939	1	(1)	18.5	0	87.8	2,400				
Do	do	October 1939	2	(1)	9.0	6.6	10.8	23,400	7.7			
Do	do	December 1939	1		3.5	11.0	1.6	91				
Do	do	January 1940	1		0	1.6	57.3	11,000				
Wilson Creek, below Sabina, Ohio	ScPRW 136	July 1939	1	7	27.5	12.8	2.3	91				
Do	do	September 1939	1	(1)	17.0	5.7	6.2	1,100				
Do	do	October 1939	2	(1)	9.0	9.1	8.6	580	8.1			
Do	do	December 1939	1		2.0	11.0	4.1	36				

[1] Less than 1.

TABLE Sc-7.—*Scioto River Basin: Ohio River pollution survey laboratory data—Summary of averages*—Continued

Sampling point	Mileage from mouth	Period	Number of samples	Average discharge cubic feet per second	Temperature °C	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per mile	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Rocky Fork Creek, above Hillsboro, Ohio.	ScPRo 122	August 1939	1		27.0	9.9	0.7	46	8.1			
Do	do	September 1939	1		20.0	6.6	.8	15	7.9			
Do	do	October 1939	1		16.0	7.8	1.2	24	7.9			
Do	do	November 1939	1		4.5	9.4	1.0	110	8.0			
Do	do	December 1939	1		7.5	10.8	.5	4	7.8			
Do	do	January 1940	1		0	12.5	.9	24	7.6			
Rocky Fork Creek, below Hillsboro, Ohio.	ScPRo 119.5	August 1939	1		24.5	7.0	.6	75	7.9			
Do	do	September 1939	1		20.0	7.1	2.4	9	7.9			
Do	do	October 1939	1		17.5	4.2	2.3	46	7.5			
Do	do	November 1939	1		5.5	11.0	1.0	8	7.8			
Do	do	December 1939	1		6.5	10.4	.6	1	7.8			
Do	do	January 1940	1		0	10.9	.5	24	7.6			
Clear Creek, above Hillsboro, Ohio	ScPRoC 122	August 1939	1		25.0	8.0	1.5	9	8.0			
Do	do	September 1939	1		20.0	3.9	.5	110	7.7			
Do	do	October 1939	1		16.0	6.7	1.3	4	7.9			
Do	do	November 1939	1		5.0	11.9	1.2	15	7.9			
Do	do	December 1939	1		7.0	11.2	.7	1	7.8			
Do	do	January 1940	1		0	12.4	.7	1	7.5			
Clear Creek, below Hillsboro, Ohio	ScPRoC 120	August 1939	1	1	24.0	7.0	.6	460	8.0			
Do	do	September 1939	1	1	20.0	4.1	1.8	9	7.5			
Do	do	October 1939	1	(1)	15.5	4.0	2.0	9	7.5			
Clear Creek, below Hillsboro, Ohio	ScPRoC 120	November 1939	1	1	5.5	10.9	1.2	110	7.7			
Do	do	December 1939	1		8.0	9.3	1.5	9	7.6			
Do	do	January 1940	1		0.0	9.6	3.7	240	7.5			
Paint Creek, station P 1, Chillicothe, Ohio.	ScP 66.6	March 1939	6		7.8	11.2	1.0	45	7.9		207	
Do	do	April 1939	8		9.9	10.3	1.4	75	7.8		192	
Do	do	May 1939	5		15.2	9.1	1.2	4	8.1		233	
Do	do	June 1939	9		23.2	7.0	2.0	428	8.0		202	
Do	do	July 1939	5		23.0	7.3	1.1	39	8.0		200	
Paint Creek, station P, Chillicothe, Ohio.	ScP 64.5	January 1939	8		5.6	12.0	9.7	85	8.0		221	
Do	do	February 1939	7		4.1	12.2	3.7	168	7.6		141	
Do	do	March 1939	9		8.3	10.8	3.4	53	7.9		197	
Do	do	April 1939	8		10.9	10.3	3.2	87	7.8		186	
Do	do	May 1939	5		18.0	8.1	7.6	17	8.2		243	
Do	do	June 1939	9		25.2	6.1	9.3	229	8.1		214	
Do	do	July 1939	5		24.0	5.7	13.3	156	8.2		214	

Scioto River, Higby, Ohio	Sc 55.7	January 1939	9	4, 182	5. 3	10. 5	5. 3	515	7. 7		213	
Do	do	February 1939	7	19, 386	3. 9	12. 0	3. 5	316	7. 6		130	
Do	do	March 1939	9	11, 840	8. 1	10. 5	3. 2	306	7. 7		158	
Do	do	April 1939	8	15, 195	11. 2	9. 6	2. 6	212	7. 7		161	
Do	do	May 1939	5	2, 374	17. 5	8. 3	3. 9	405	8. 0		232	
Do	do	June 1939	9	6, 969	24. 5	5. 3	2. 8	429	7. 8		190	
Do	do	July 1939	5	2, 568	24. 0	5. 9	2. 8	427	7. 9		197	
Little Salt Creek, 1 mile above Jackson, Ohio.	ScSL 76	July 1939	2			4. 1	2. 2	33				
Little Salt Creek, upper edge Jackson, Ohio.	ScSL 75	July 1939	2			7. 9	2. 2	70				
Little Salt Creek, lower end of Jackson, Ohio.	ScSL 74	July 1939	2			3. 8	2. 2	195				
Little Salt Creek, 2½ miles below Jackson, Ohio.	ScSL 72	July 1939	2			3. 6	2. 0	17				
Salt Creek, at mouth	ScS 51.4	January 1939	5		5. 2	12. 5	1. 1	64	7. 2		48	
Do	do	February 1939	3		5. 5	11. 9	1. 3	125	7. 2		45	
Do	do	March 1939	5		7. 4	11. 5	1. 2	43	7. 2		54	
Do	do	April 1939	4		10. 6	10. 7	. 8	50	7. 2		58	
Do	do	May 1939	1		13. 0	10. 2	. 9	15	7. 5		96	
Do	do	June 1939	1		24. 0	6. 9	1. 2	46	7. 7		144	
Scioto River, Waverly, Ohio	Sc 38.7	January 1939	9	4, 689	5. 2	11. 0	3. 5	208	7. 7		187	
Do	do	February 1939	7	21, 730	4. 0	11. 9	2. 9	248	7. 6		122	
Do	do	March 1939	9	13, 272	8. 1	10. 4	2. 6	249	7. 6		151	
Do	do	April 1939	7	11, 201	11. 1	9. 5	2. 0	152	7. 7		159	
Do	do	May 1939	5	2, 664	17. 4	8. 7	3. 0	38	8. 0		226	
Do	do	June 1939	9	7, 820	24. 4	5. 8	2. 5	136	7. 7		183	
Do	do	July 1939	5	2, 880	23. 9	6. 5	2. 0	120	7. 9		194	
Scioto River, Lucasville, Ohio	Sc 15.5	January 1939	9	5, 037	4. 7	11. 5	2. 5	200	7. 7		173	
Do	do	February 1939	7	23, 343	3. 6	11. 9	2. 6	333	7. 6		117	
Do	do	March 1939	9	14, 244	7. 7	10. 5	2. 1	129	7. 6		145	
Do	do	April 1939	7	12, 043	10. 9	9. 5	1. 5	84	7. 7		155	
Do	do	May 1939	5	2, 858	17. 0	8. 9	2. 4	26	8. 0		226	
Do	do	June 1939	9	8, 390	24. 3	6. 5	2. 2	63	7. 8		184	
Do	do	July 1939	5	3, 092	23. 7	7. 2	1. 9	8	7. 9		194	
Do	do	September 1939	5	458	21. 7	7. 6	3. 0	3	8. 0	28	222	
Do	do	October 1939	4	349	15. 4	8. 2	2. 7	3	8. 0	24	267	
Do	do	November 1939	5	571	7. 2	10. 0	1. 8	6	7. 9	18	229	
Do	do	December 1939	3	610	6. 2	10. 2	1. 9	2	7. 8	10	229	
Do	do	January 1940	1	405	. 5	10. 4	3. 7	9	7. 6	7	271	

[1] Less than 1.

MIAMI RIVER BASIN

CONTENTS

	Page
Contents	603
Syllabus and conclusions	605
Description	607
Presentation of field data	607
Presentation of laboratory data	610
Hydrometric data	612
Discussion	615

LIST OF TABLES

Mi–1.—Cost estimates of remedial measures	606
Mi–2.—Surface water supplies	608
Mi–3.—Sources of pollution	608
Mi–4.—Industrial wastes	609
Mi–5.—Selected laboratory data	610
Mi–6.—Mean monthly summer flows	614
Mi–7.—Summary of laboratory data	618

LIST OF FIGURES

Mi–1. Map—Sources of pollution	605
Mi–2. Chart—Sources of pollution and selected laboratory data	608
Mi–3. Map—Coliform results	610
Mi–4. Map—Dissolved oxygen results	610
Mi–5. Map—Biochemical oxygen demand results	610
Mi–6. Chart—Summer low-flow frequency curve	613

Fig. Mi-1

Fig. Mi-1

MIAMI–LITTLE MIAMI BASINS

SOURCES OF POLLUTION

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

MIAMI RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Miami Basin comprises 3,950 square miles in southwestern Ohio and 1,435 square miles in southeastern Indiana and has a population of about 800,000, of which more than 60 percent is urban. The valley of the Miami River is one of the most densely populated and highly industrialized areas in the Ohio Basin and the pollution load is heavy. Progress has been made toward pollution abatement, treatment being practiced at municipalities representing about 75 percent of the sewered population. Industrial wastes are important, and limitations in practical known methods of industrial waste treatment are controlling factors in certain cases. Pollution control by increasing low flow does not appear promising. Present minimum flows are relatively high, and significant increases in these flows would require large storage.

CONCLUSIONS

(1) The abundance of satisfactory underground water has reduced the need for clean streams as sources of water supply, but it seems probable that surface sources will be used more extensively in the future. The upper Mad River and the Whitewater River are especially valuable as recreational streams and the increasing demand for recreational facilities warrants the maintenance of high standards of water quality in these streams.

(2) Sewage from 550,500 people in 64 communities and industrial wastes equivalent to sewage from an additional 401,500 people are discharged to sewers. Thirty-one communities have installed sewage-treatment plants which treat the sewage from about 75 percent of this population and 40 percent of the industrial waste population equivalent, reducing the total pollution load of 952,000 to a sewered population equivalent of about 482,700, of which nearly 80 percent enters the Miami River directly.

(3) The general picture presented by the laboratory results indicates (*a*) a relatively clean area in the Whitewater River Basin and on certain smaller tributaries; (*b*) considerably more pollution of the upper Miami Basin above Dayton, but partial recovery of the streams before receiving successive pollution loads; and (*c*) generally unsatisfactory conditions for most uses in the Mad River below Springfield and in the Miami River from below Dayton to near the mouth.

(4) The principal pollution problem is on the main Miami River from below Dayton to a point near the mouth. Residual pollution following sewage treatment, plus industrial wastes for which only limited methods of treatment are available, prevent a high degree of restoration of the river. Suggested sewage treatment plus the possible industrial waste correction should restore the stream for reason-

able use other than domestic water supply except during times of abnormally low flow.

(5) Low-flow regulation by proposed reservoirs on the Whitewater River would have largely intangible value. The existing Miami Conservancy District reservoirs have unregulated outlets and hence have no effect on low flows.

(6) Piqua obtains part of its water supply from the main Miami River 13 miles below Sidney. A high degree of sewage treatment appears justified at Sidney to protect this supply.

(7) A few sections of tributary streams receive pollution in excess of a reasonable limit. These are primarily local problems and the tributaries are of equal or better quality than the Miami River at the point of confluence.

(8) In view of the uses of the streams involved, refined treatment at certain sources of pollution would serve no purpose commensurate with the expenditure. In these instances, lesser treatment appears justified. In other cases, limitations in practical known methods of industrial waste treatment is a governing factor. In such cases refined methods of sewage treatment would cause no valuable improvement and lesser treatment appears justified. A summary of comparative costs of remedial measures from table Mi–1 follows:

Treatment	Capital cost	Annual charges
Existing	$9, 380, 000	$745, 000
Suggested additional	4, 860, 000	660, 000

Estimated additional costs over existing charges of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	$4, 070, 000	$570, 000
Secondary, all places	5, 450, 000	730, 000

TABLE Mi–1.—*Miami River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	10	21	422, 400	$9, 380, 000	$555, 000	$190, 000	$745, 000
Suggested minimum correction:							
Sewage treatment plants	7	18	127, 200	2, 120, 000	150, 000	95, 000	245, 000
Required interceptors				1, 560, 000	75, 000		75, 000
Independent industrial waste correction				1, 180, 000	155, 000	185, 000	340, 000
Total				4, 860, 000	380, 000	280, 000	660, 000
Comparative cost:							
Primary treatment all waste				4, 070, 000	320, 000	250, 000	570, 000
Secondary treatment all waste				5, 450, 000	415, 000	315, 000	730, 000
As suggested				4, 860, 000	380, 000	280, 000	660, 000

Description

The Miami River Basin has a total area of 5,385 square miles, of which 3,950 square miles are in southwestern Ohio and the balance in southeastern Indiana. The river rises in Logan County, Ohio, and flows in a generally southwesterly direction to join the Ohio River at the Ohio-Indiana State Line.

	Miles above mouth of Miami River	Drainage area, square mile
Major tributaries:		
Whitewater River	5	1, 590
Fourmile Creek	38	320
Twin Creek	60	320
Mad River	85	660
Stillwater River	86	670
Loramie Creek	126	260

	Populations			
	1910	1920	1930	1940
Larger cities:				
Dayton, Ohio	116, 577	152, 559	200, 983	210, 718
Springfield, Ohio	46, 921	60, 840	68, 743	70, 662
Hamilton, Ohio	35, 279	39, 675	52, 176	50, 592
Richmond, Ind	22, 324	26, 765	32, 493	35, 147
Total basin:				
Rural	283, 598	290, 054	299, 370	328, 377
Urban	300, 439	378, 913	480, 484	502, 104
Total	584, 037	668, 967	779, 854	830, 481

Although agriculture in the Miami Basin is important, industrial activities predominate. The most important of these are the metal and paper industries. Other industries of lesser importance include canning, milk, and textiles.

Water uses.—Five communities with a total population of about 100,000, secure their water supply from surface streams. Only one, Piqua, uses the main Miami River. The Whitewater and Mad Rivers are used extensively for recreational purposes. Flood control works of the Miami Conservancy District include five retarding dams which are not operable to augment low flows.

Presentation of Field Data

Figure Mi–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure Mi–2 shows similar data, and, in addition, the location of water supply intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen, and biological oxygen demand.

Public water supplies.—Ground water of generally good chemical quality appears to be plentiful in most sections of the basin. Sixty-four public water supply systems serve about 600,000 people. Fifty-nine of these supplies, which serve about 500,000 people, are from underground sources. The other 5 supplies, taken wholly or in part from surface sources, are listed in table Mi–2. All of these are

in Ohio. The Springfield supply, although taken from an infiltration gallery, is considered by the State health department to be a surface supply. The city has experienced considerable difficulty in developing an adequate and safe supply from underground sources and may be forced to use one of the nearby streams or to construct an impounding reservoir.

TABLE MI-2.—*Miami River Basin: Surface water supplies*

Municipality	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls				
Greenville	Greenville Creek, well	139	LD	7,500	0.50
Piqua	Miami River, impounded	122	LD	17,000	1.75
	Other surface supplies				
Eaton	Fourmile Creek	67	FD	3,500	0.25
Centerville	Lake	82	LD	300	.01
Springfield	Buck Creek (infiltration gallery)	111	D	73,000	10.00
Total:					
Below sewer outfalls				24,500	2.25
Other				76,800	10.26
Total surface water supplies				101,300	12.51

[1] Miles above mouth of Miami River.
[2] L=Lime-soda softened; D=chlorinated; F=coagulated, settled, filtered.

Sewerage.—Public sewerage systems serve 64 municipalities with a combined population of about 550,000, of which 390,000 or about 70 percent, reside in the area from Hamilton to Dayton (mile 33 to 85). Twenty-seven pollutional sources of consequence are shown in table Mi-3. Secondary treatment of waste is provided at 21 communities serving 333,000 or about 60 percent of the total sewered population. Primary treatment is provided at 10 municipalities serving 89,000 population.

TABLE MI-3.—*Miami River Basin: Sources of significant pollution including industrial waste expressed as sewered population equivalent* (*biochemical oxygen demand*)

Municipality	Stream	Miles above mouth of Miami River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand): Untreated	Sewered population equivalent (biochemical oxygen demand): Discharged
Hooven	Miami River	8			12,700	12,700
Hamilton	do	35	54,600	None	86,500	86,500
Middletown	do	53.6	35,000	do	69,900	69,900
Franklin	do	61.3	4,000	Secondary	56,800	[1] 53,400
Miamisburg	do	68.6	5,300	None	6,600	6,600
West Carrollton	do	72	1,800	do	29,300	29,300
Moraine City	do	76.4	3,000	Secondary	3,000	500
Dayton	do	82.4	250,000	do	375,500	40,500
Tipp City	do	104.5	2,500	do	27,100	[1] 22,900

[1] Sewage-treatment plant, under construction at time of laboratory survey (1939), now completed.

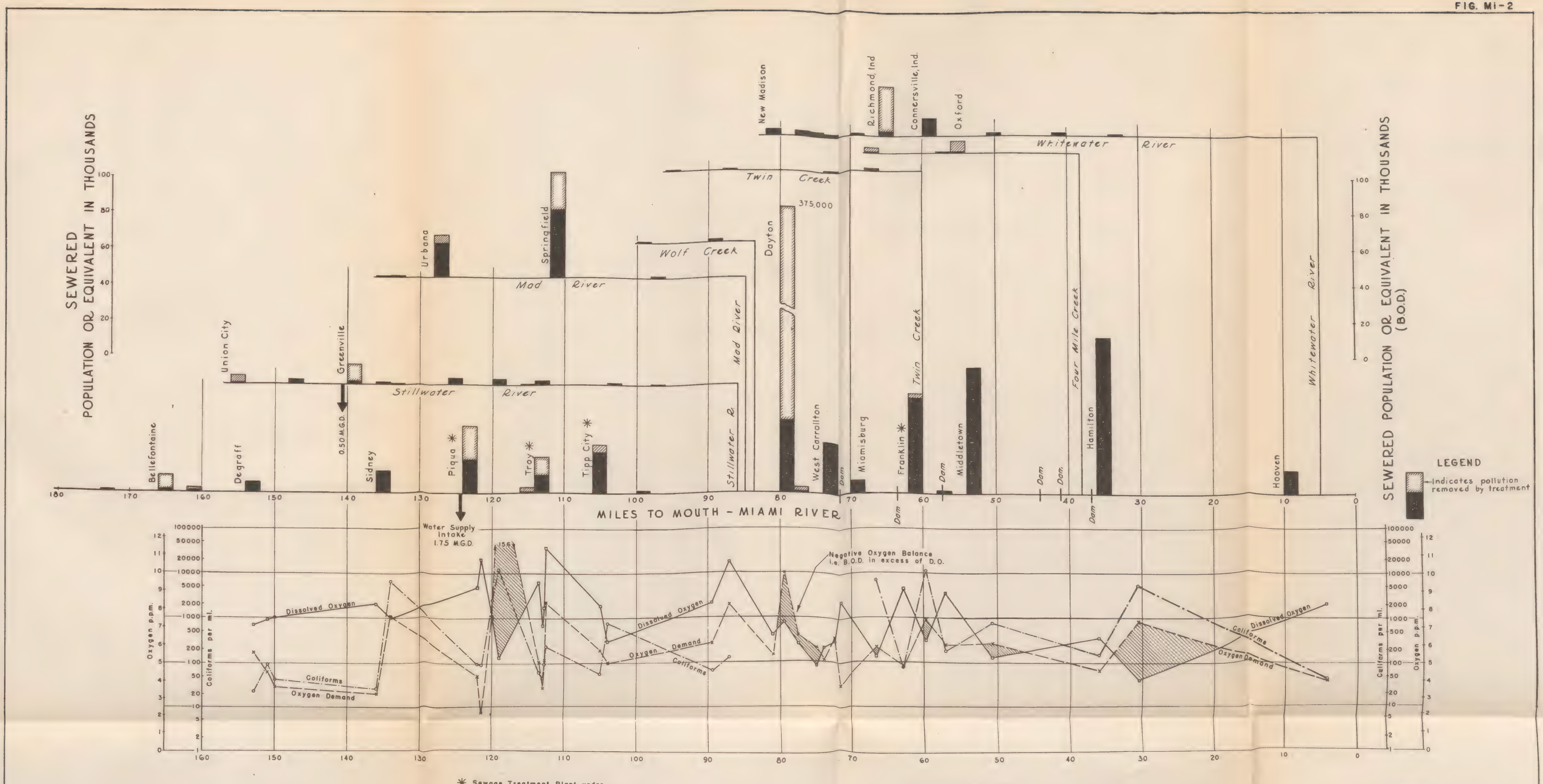


FIGURE Mi-2
MIAMI RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY RESULTS
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE

TABLE MI-3.—*Miami River Basin: Sources of significant pollution including industrial waste expressed as sewered population equivalent (biochemical oxygen demand)*—Continued

Municipality	Stream	Miles above mouth of Miami River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Troy	Miami River	113.1	9,800	Chemical precipitation.	19,800	[1] 9,900
Piqua	do	122.1	15,800	do	37,500	[1] 18,800
Sidney	do	134.8	9,500	None	11,900	11,900
New Carlisle	Honey Creek	114	1,000	Secondary	3,100	500
DeGraff	Buckingahelas Creek	152			5,800	5,800
Bellefontaine	Possum Run	165	9,000	Secondary	9,000	1,400
Connersville	West Fork Whitewater River	59	9,800	None	9,800	9,800
Richmond	East Fork Whitewater River	65	28,000	Secondary	28,000	1,200
New Madison	do	81	300	None	3,300	3,300
Oxford	Fourmile Creek	55	6,500	Secondary	6,500	1,000
Eaton	Sevenmile Creek	67	3,200	do	3,200	500
Springfield	Mad River	111	59,000	Primary	59,000	38,000
Urbana	Dugan Run	126	6,000	Secondary	23,700	19,000
Covington	Stillwater River	119	1,400	None	3,000	[2] 3,000
Bradford	Ballinger Run	125	500	do	3,400	3,400
Greenville	Greenville Creek	139	7,100	Secondary	11,000	2,200
Ansonia	Stillwater River	147	300	None	2,800	2,800
Union City	Dismal Creek	154	1,100	Secondary	4,700	700
Small sources (in 44 towns)			26,000	Various	39,100	27,200
Total			550,500		952,000	482,700

[1] Sewage-treatment plant, under construction at time of laboratory survey (1939), now completed.
[2] Sewage-treatment plant, under construction (1941).

Industrial waste.—Eighty-six industrial plants, wholly or partly unconnected to municipal treatment, are summarized in table Mi-4. Numerous waste producing industrial plants discharge to municipal treatment facilities, particularly at Dayton, Ohio, where an industrial load of about 120,000 reaches the treatment plant. The industrial waste load in the basin, as biological oxygen demand, totals about 401,000 population equivalent.

TABLE MI-4.—*Miami River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Ohio:					
Canning	10	2	8	4	22,700
Meat	6	2	4	2	3,200
Metal	8	4	4	3	
Milk	14	7	7	3	1,500
Paper	21	5	16	17	167,000
Miscellaneous	10	6	4	4	36,800
Total	69	26	43	33	231,200
Indiana:					
Canning	4	0	4	2	4,100
Metal	11	8	3	5	
Miscellaneous	2	1	1		
Total	17	9	8	7	4,100
Waste unconnected municipal treatment	86	35	51	40	235,300
Waste connected to municipal treatment					166,200
Total industrial waste in basin					401,500

Presentation of Laboratory Data

Laboratory data for the Miami River Basin are presented in table Mi–7 (p. 618). All samples on the Whitewater River and along the Miami River from Miamisburg to the mouth were analyzed at the Cincinnati laboratory from one to three times monthly during the period February 1939 to April 1940. Six stations immediately above Dayton and six stations below Dayton's sewage treatment plant were sampled from three to five times monthly and analyzed by personnel of the Dayton plant during the period June to December, 1939. All remaining points were sampled from one to three times by a mobile laboratory unit in September 1939.

Selected monthly average results at some of the principal points in the basin are tabulated with flows on sampling days and during the minimum month of record in table Mi–5. In general, the results selected represent the lowest flow conditions during the sampling period.

Table Mi–5.—*Miami River Basin: Selected laboratory data*

River	Miami	Miami	Miami at Dayton	Miami at Dayton	Miami at Dayton	Miami	Miami
Location	Above Sidney	Below Sidney	Above Outfall	One-half mile below	5 miles below	Above Miamisburg	Below Miamisburg
River miles above mouth of Miami.	136	134	83	82	77.5	71.6	66.5
Period, 1939	September	September	September	September	September	October	October
Number of samples	3	2	4	4	4	2	2
Flow in cubic feet per second:							
Sampling days	72	66	313	----------	----------	540	540
Minimum month	22	22	226	----------	----------	----------	----------
Water temperature, °C	17.7	17.5	24.4	24.2	23.3	17.8	17.8
Coliforms per milliliter	26	6,650	----------	----------	----------	680	635
Dissolved oxygen, parts per million	8.3	7.5	6.5	7.2	4.8	6.9	5.0
Biological oxygen demand, 5-day, parts per million	3.3	7.6	5.4	10.0	5.8	3.2	4.3

River	Miami	Miami	Miami	Miami	Miami	Miami	Miami
Location	Above Franklin	Below Franklin	Above Middletown	Below Middletown	Above Hamilton	Below Hamilton	Cleves Bridge
River miles above mouth of Miami	62.8	59.6	57	50.8	35.9	30.4	4.2
Period, 1939	October	October	October	October	September	September	September
Number of samples	2	2	2	2	3	3	6
Flow in cubic feet per second:							
Sampling days	555	555	560	560	747	747	696
Minimum month	----------	----------	----------	----------	286	286	----------
Water temperature, °C	17.3	17.3	15.5	18.0	24.2	23.5	21.8
Coliforms per milliliter	190	24,800	126	660	140	5,200	41
Dissolved oxygen, parts per million	7.2	4.3	8.2	4.2	6.4	4.0	8.3
Biological oxygen demand, 5-day, parts per million	4.0	7.8	3.1	8.6	4.6	7.3	4.0

Fig. Mi-3

LEGEND
Average Coliform Results at Sampling Stations.

Symbol	Most probable number per ml.
○	Under 25
◔	26–50
◑	51–100
◕	101–200
●	Over 200

Fig. Mi-3
MIAMI–LITTLE MIAMI BASINS
COLIFORM RESULTS

10 0 10 20
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Mi-4

MIAMI—LITTLE MIAMI BASINS

DISSOLVED OXYGEN RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

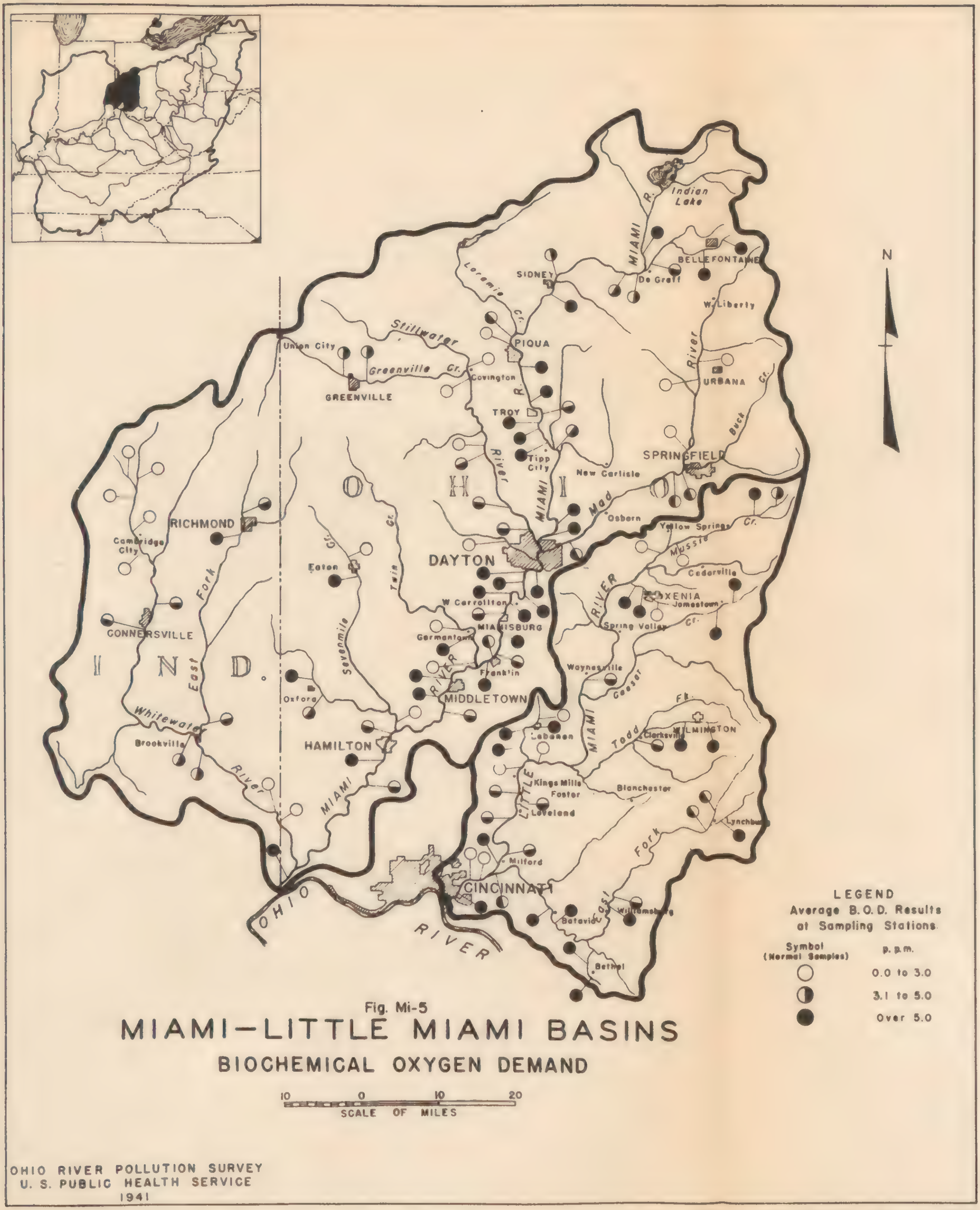


Fig. Mi-5

MIAMI—LITTLE MIAMI BASINS

BIOCHEMICAL OXYGEN DEMAND

TABLE MI-5.—*Miami River Basin: Selected laboratory data*—Continued

River	Stillwater	Stillwater	Stillwater	Mad	Mad	Mad	Mad
Location	Above Covington	Below Covington	Mouth	Above Urbana	Below Urbana	Above Springfield	Below Springfield
River miles above:							
Confluence with Miami	34	32	0	42	40	27	26
Mouth of Miami	120	118	86	127	125	112	111
Period, 1939	September	September	September	September	September	September	September
Number of samples	2	2	4	2	2	3	2
Flow in cubic feet per second:							
Sampling days	12	12	----------	65	65	185	199
Minimum month	----------	----------	----------	40	40	114	114
Water temperature, °C	19.0	20.0	21.7	16.8	17.5	14.8	17.3
Coliforms per milliliter	13	1,900	178	15	219	152	235
Dissolved oxygen, parts per million	6.0	4.0	7.3	8.7	8.3	8.2	5.7
Biological oxygen demand, 5-day, parts per million	2.2	2.4	2.3	1.4	2.3	2.1	4.2

River	West fork Whitewater	West fork Whitewater	East fork Whitewater	East fork Whitewater	Whitewater at Brookville	Whitewater at Brookville	Whitewater at Brookville
Location	Above Connersville	Below Connersville	Above Richmond	Below Richmond	West fork above	East fork above	Below
River miles above:							
Confluence with Miami	57	56	61	60	28	28	26
Mouth of Miami	62	61	66	65	33	33	31
Period, 1939	September	September	October	October	September	September	September
Number of samples	1	1	1	1	1	1	1
Flow in cubic feet per second:							
Sampling days	69	69	37	37	----------	----------	140
Minimum month	47.1	47.1	----------	----------	----------	----------	95.5
Water temperature, °C	16.5	19.0	23.0	22.0	17.5	18.5	18.0
Coliforms per milliliter	4	460	240	240	4	24	240
Dissolved oxygen, parts per million	8.2	7.2	5.0	5.7	8.2	8.0	8.2
Biological oxygen demand, 5-day, parts per million	1.2	2.0	1.6	2.1	.9	1.1	.9

Stream-flow conditions varied from high discharges in the spring and early summer of 1939 and the early spring of 1940 to moderately low discharges in the late summer and winter of 1939–40. Bad ice conditions were present in January 1940.

Spot symbol maps showing the average coliform, dissolved oxygen, and oxygen demand results are shown in figures Mi–3, Mi–4, and Mi–5, respectively. The results represent the most unfavorable monthly averages observed at each station sampled over a period of several months and the average of all samples at each station sampled for less than 1 month.

In the basin as a whole, 55 percent of all stations had an average coliform count of more than 200 per milliliter for at least 1 month during the period of observation; 26 percent of all stations had most unfavorable average counts of from 50 to 200 per milliliter; and 19 percent of all stations had coliform averages of less than 50 per milliliter for the most unfavorable monthly average condition during the period of observation. The highest counts were observed below Bellefontaine. High coliform counts also were observed below Piqua,

Greenville, and Springfield and along the main stream from Dayton to below Hamilton. Moderately high counts were found below Richmond, Connersville, and Brookville on the Whitewater River. Coliform counts are omitted from the results of those samples examined at the Dayton sewage-treatment plant as these results were expressed in the Phelps' index instead of most probable number as were all other results. Coliform counts at stations immediately above sources of pollution were lowest during the period September 1939 to January 1940, coinciding with the fall and winter low-flow period. The coliform counts at stations immediately below sources of pollution were more erratic in this respect.

The dissolved oxygen results, considering the basin as a whole, were fairly good. Minimum monthly averages were generally in excess of 6.5 parts per million. Except at Bellefontaine, where zero dissolved oxygen was found, the lowest averages observed were over 3.0 parts per million. The lowest values were found during the months of June to October, when temperatures and oxygen-demand values were highest. The most consistently low values were found in the stretch from Dayton to below Hamilton on the main river.

The highest monthly average biochemical oxygen demand results at 36 percent of the stations were in excess of 5.0 parts per million. At 38 percent of the stations the most unfavorable monthly average was between 3.1 and 5.0 parts per million and at 26 percent of the stations it was 3.0 or less. The station immediately below Bellefontaine had the highest biochemical oxygen demand observed in the basin, 36.6 parts per million. The station below Piqua was next, with 15.6 parts per million. Oxygen demands of from 4 to 6 parts per million were general throughout the period of observation in the Miami River from Dayton to the mouth. On the Whitewater River results were generally less than 3.0 parts per million and often less than 1.0 part per million. The highest values observed at Richmond, Connersville, and Brookville followed the ice conditions of January 1940.

Biological summary.—The flora and fauna of the Miami River were found to be abundant in species and number, especially in the stretch below Dayton. This is due to the population concentration in the cities along the stream. The average volume of plankton at the various stations along the main stream ranged from 3,000 to 8,000 parts per million, a high concentration of plankton. The plankton volume of the tributaries—the Whitewater, Stillwater, and Mad Rivers—was found to be less than 3,000 parts per million.

Hydrometric Data

Twenty-six stream-gaging stations have been maintained on the Miami River Basin for varying periods, 14 of which are in operation at the present time. Two active stations are in Indiana and all other stations, active and inactive, are in Ohio. Eight stations of importance from the pollution standpoint have been selected and the monthly mean summer flows for 3 years in which the low summer flows have occurred are presented in table Mi–6.

Fig. Mi-6

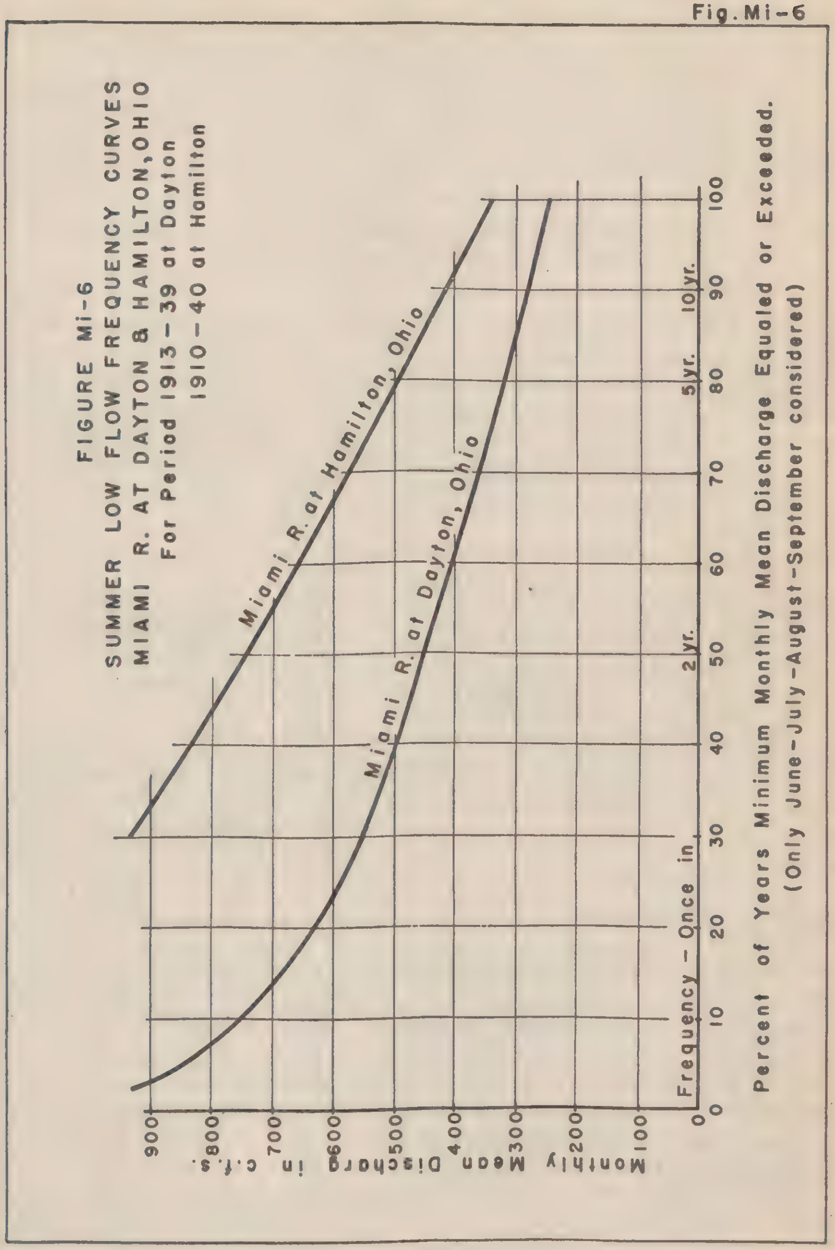


FIGURE Mi-6
SUMMER LOW FLOW FREQUENCY CURVES
MIAMI R. AT DAYTON & HAMILTON, OHIO
For Period 1913 – 39 at Dayton
1910 – 40 at Hamilton
Miami R. at Hamilton, Ohio
Miami R. at Dayton, Ohio
Monthly Mean Discharge in c.f.s.
900 800 700 600 500 400 300 200 100 0
0 10 20 30 40 50 60 70 80 90 100
Frequency – Once in
2 yr.
5 yr.
10 yr.
Percent of Years Minimum Monthly Mean Discharge Equaled or Exceeded.
(Only June-July-August-September considered)

Figure Mi–6 presents summer low-flow frequency curves from June to September, inclusive, for the Miami River at Dayton and Hamilton, Ohio. These curves indicate that the frequency with which various minimum monthly mean flows may be expected is as follows:

Location	Minumun monthly mean summer flows in cubic feet per second that may be expected once in—				
	1 year	2 years	5 years	10 years	Minimum
Dayton, Ohio	1,770	450	320	280	240
Hamilton, Ohio	2,800	740	490	410	340

TABLE MI–6.—*Miami River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Miami	Miami	Miami	Miami
Location	Hamilton	Dayton	Taylorsville	Sidney
River miles above mouth of Miami	35	82	94	135
Drainage area, square miles	3,639	2,510	1,160	545
Period of record	1910–40	1915–40	1922–40	1914–40
Year	1930	1932	1932	1932
June, cubic feet per second	845	1,220	430	227
July, do	492	1,120	371	118
August, do	458	323	84	38
September, do	589	311	80	38
Year	1934	1934	1934	1934
June, cubic feet per second	445	336	146	58
July, do	482	263	101	[1] 25
August, do	582	399	175	38
September, do	357	[1] 240	73	28
Year	1936	1936	1936	1936
June, cubic feet per second	620	430	125	61
July, do	[1] 335	254	[1] 71	40
August, do	391	255	73	34
September, do	516	326	97	38

River	Whitewater	Twin Creek	Mad River	Stillwater
Location	Brookville	Germantown	Springfield	Pleasant Hill
River miles above:				
Confluence with Miami	27	7	26	28
Mouth of Miami	32	67	111	115
Drainage area, square miles	1,190	275	485	502
Period of record	1928–40	1914–40	1914–40	1916–26, 1935–40
Year	1930	1928	1923	1924
June, cubic feet per second	257	522	276	2,120
July, do	141	216	196	137
August, do	102	30	210	35
September, do	201	12	171	24
Year	1934	1930	1934	1935
June, cubic feet per second	161	25	130	232
July, do	136	9	115	102
August, do	164	[1] 6	150	30
September, do	[1] 111	15	[1] 114	30
Year	1936	1936	1936	1936
June, cubic feet per second	226	23	192	44
July, do	139	12	137	29
August, do	163	27	137	[1] 24
September, do	509	89	201	26

[1] Minimum month.

Proposed stream control.—A study to determine the feasibility of adapting the five existing Miami Conservancy District flood-control reservoirs in the comprehensive flood-control plan for the Ohio River is being made in connection with a survey report being prepared by the United States Engineer Department. A study also is being made to determine the feasibility of constructing two or more reservoirs on the Whitewater River watershed in this same survey report. Consideration is being given in these studies to the operation of the reservoirs for pollution abatement. The Whitewater River reservoirs would have little value for pollution abatement since the unregulated flow below them is large enough to eliminate the need for more than primary treatment. The need for flow regulation on the lower Miami is discussed in the following section of this report.

Discussion

The principal pollution problem in the Miami River Basin is on the Miami River from Dayton to a point near the mouth. A lesser pollution problem exists on the upper Miami River below Sidney where pollution affects the water supply of Piqua. Minor pollution problems, of primarily local significance, exist at various points below 14 moderate-sized and small municipalities. Corrective measures at these points are included in the cost estimates, but discussion is not included.

MAIN MIAMI RIVER BELOW DAYTON

Between Dayton and Hamilton, the most seriously polluted section, the Miami River receives wastes from a sewered population equivalent of about 300,000. Two large tributaries, Twin Creek and Fourmile Creek, enter the river in this section with beneficial effects on the quality of the water of the main stream. Pollution is due almost entirely to the discharge of sewage and industrial wastes at Dayton, West Carrollton, Miamisburg, Franklin, Middletown, and Hamilton. Dayton, and more recently Franklin, have constructed plants for the secondary treatment of sewage. The other cities have no sewage-treatment plants at the present time. At Franklin a considerable amount of industrial wastes enters the Miami directly without treatment.

During the low-water month of September 1939 the Miami River above Dayton had a high biochemical oxygen demand (5.4 parts per million), but the dissolved oxygen was satisfactory for all uses. Pollution appeared to be assimilated without serious nuisance in the stream with the small dilution available, due probably to oxygen demand reduction by sedimentation behind dams, reaeration over the six dams and because of the distance between points of waste discharge (8 to 12 miles) permitting partial recovery between sources of pollution. Despite the absence of gross nuisances from pollution, the dissolved oxygen fell to 5.0 parts per million or less below every city of consequence in this stretch of the river. The minimum was 4.0 parts per million below Hamilton.

A number of factors make it extremely difficult, for the present at least, to secure a high degree of restoration of the Miami River from below Dayton to the mouth. These factors include the residual pollution load represented by the treatment plant effluent at Dayton,

which cannot be appreciably reduced except at excessive cost: the presence of sewage from other communities from which there will always be some residual pollution even following treatment; and the discharge of industrial wastes for which only limited methods of treatment are now available.

The paper pulp and paper industry is an important contributor of organic pollution in this area. Considerable progress has already been made toward controlling this pollution. In certain cases further corrective steps can be taken such as the use of closed water systems, the installation of save-alls and waste treatment. Consideration of the paper and other types of industry in this area, and the experience in treating similar wastes elsewhere, leads to the conclusion that treatment may reduce the industrial pollution load possibly 30 percent by proven methods, or from 157,100 to 111,000, based on oxygen demand sewered population equivalent. Reduction in suspended solids might be greater. As part of the present industrial pollution load represents a residual after treatment, such loads cannot readily be further reduced at a reasonable cost.

Lower flows than those which occurred in September 1939 occur frequently at Dayton. Normal population and industrial growth in the future will increase the pollution load in this area.

The addition of secondary treatment at Dayton in 1939 went far in correcting pollution in the Miami River below this community. Even with complete treatment, the river below Dayton will have to be relied upon to supplement artificial purification by natural processes, so that a section of varying length below this community is still, and probably will continue to be, a critical section as regards oxygen balance. Above Miamisburg, about 11 miles below the Dayton sewer outfall, natural recovery raises the dissolved oxygen temporarily to a satisfactory level (6.9 parts per million). In the low-flow month of September 1939 pollution below this point reduced the dissolved oxygen successively to 5.0, 4.3, 4.2, and 4.0 parts per million with satisfactory dissolved oxygen recovery below each successive entrance of pollution. This pollution is capable of considerable reduction by known economical methods.

In view of the above facts, it appears impractical to attempt further improvement of the stream immediately below Dayton. However, improvement of the river below Miamisburg and lower points appears possible and justified.

Primary treatment of sewage at Hamilton, Middletown, Miamisburg, and West Carrollton, in addition to certain treatment and other corrective measures for industrial wastes should greatly improve the lower river. Except during abnormally dry years, this improvement should be sufficient for all present and reasonable future uses of the stream including the support of all but the highest type of fish.

While secondary treatment of sewage would further reduce the pollution, it is doubtful, due to the present limitations in possible economical methods for treatment of industrial wastes, if any useful purpose or valuable improvement commensurate with the cost of such treatment would result.

Primary-treatment works, built with a view to addition of secondary treatment facilities at a later date, are amply warranted. Research should be applied to the development of more efficient methods of

industrial-waste treatment. Should such methods be developed, secondary treatment of sewage might well be justified.

The possibility of low-flow regulation as a means of improving conditions in this area has been considered. Reservoir sites of the size necessary to afford much regulation of value to the lower Miami are practically limited to the ones already constructed by the Miami Conservancy District. These flood-control reservoirs have no permanent pools and unregulated outlets. The United States Engineer Department is now studying the feasibility of providing outlet control works at these dams.

If, by using these reservoirs for low-flow regulation, flows ranging from about 400 cubic feet per second at Dayton to about 700 cubic feet per second at Hamilton could be provided during the summer months, stream conditions could be greatly improved. The program of sewage and industrial-waste treatment outlined above would still be necessary, but the need for more complete treatment would be deferred or possibly eliminated. Relatively large storage capacities would be required to provide the necessary supplemental low flow.

SIDNEY

One of the few surface-water supplies on the Miami River Basin is at Piqua. Water is taken from the main Miami River about 13 miles below Sidney. A high standard of water quality should be maintained to safeguard this water supply. Under the circumstances, secondary treatment of all wastes at Sidney as justified to take the place of the present discharge of untreated sewage.

MISCELLANEOUS POLLUTION

A number of minor sources of wastes on the Miami River and its tributaries cause serious pollution of primarily local significance. Remedial measures appear justified at Connersville and New Madison in the Whitewater River Basin, Springfield and Urbana in the Mad River Basin, and Bradford and Ansonia in the Stillwater River Basin. Some industrial-waste correction is needed at most of these places.

Cost estimates for remedial measures for pollution abatement suggested, as justified by the stream uses are summarized on table Mi–1.

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Miami River, above Degraff, Ohio	Mi 153	Sept. 21, 1939	62	17.5	7.1	73.5	5.6	23	8.2	100	156	
Jacket Creek, bridge on US 33, above Bellefontaine, Ohio.	MiBuJ 171	Sept. 13, 1939	24	18.0	0	0	19.5	15,000	7.6	5	395	
Jacket Creek, ¼ mile southwest of Bellefontaine, Ohio.	MiBuJ 170	do		20.0	0	0	25.0	110,000	7.5	10	400	
Do	do	Sept. 19, 1939		15.0	0	0	36.2	240,000	7.5	41		
Buckongahelas Creek, above Degraff, Ohio.	MiBu 153	Sept. 21, 1939		15.0	4.4	43.3	3.4	930	7.8	10	284	
Miami River below Degraff, Ohio	Mi 151	do	62	17.5	7.4	77.3	4.5	93	7.9	102	162	
Miami River, above Quincy, Ohio	Mi 150	do		17.5	7.5	78.2	3.7	43	8.0	98	200	
Miami River, above Sidney, Ohio	Mi 136	Sept. 13, 1939		19.0	9.0	96.5	2.1	9	8.1	38	270	
Do	do	Sept. 19, 1939		19.0	7.9	84.9	3.9	46	8.4	93	238	
Do	do	Sept. 22, 1939		15.0	7.9	77.9	3.9	24	8.3	76		
Miami River, 1 mile south on U. S. Route 25, Sidney, Ohio.	Mi 134	Sept. 13, 1939		20.0	7.3	79.3	8.4	11,000	8.1	25	270	
Do	do	Sept. 22, 1939		15.0	7.7	75.8	6.8	2,300	8.1	83		
Miami River, ½ mile above Piqua, Ohio.	Mi 122	Sept. 19, 1939		20.5	9.9	109.1	5.8	28	8.2	41		
Do	do	Sept. 21, 1939		20.0	9.3	101.2	3.2	23	8.3	48	245	
Do	do	Sept. 25, 1939		20.0	8.3	90.6	3.8	240	8.3	43	235	
Miami River, bridge, U. S. Route 25, above Piqua, Ohio.	Mi 121.5	Sept. 13, 1939	74	21.0	10.8	120.1	2.1	93	8.3	35	257	
Miami River, lower city limits, Piqua, Ohio.	Mi 120	do	74	21.0	7.6	84.6	7.6	2,400	8.1	25	260	
Miami River, 1 mile below city limits, Piqua, Ohio.	Mi 119	Sept. 19, 1939		21.5	5.2	58.9	11.8	24,000	7.8	64		
Do	do	Sept. 21, 1939		20.0	4.5	49.0	20.5	2,300	6.7	155	150	
Do	do	Sept. 25, 1939		21.0	6.1	67.5	14.4	9,300	7.4	65	200	
Miami River, above Troy, Ohio	Mi 113.5	Sept. 14, 1939		27.0	10.7	132.2	5.0	36	8.3	35	254	
Do	do	Sept. 18, 1939		21.0	7.9	87.7	5.4	110	8.2	35		
Do	do	Sept. 22, 1939		20.5	9.8	108.4	4.8	36	8.2	34	235	
Miami River, bridge on Route 70, below Troy, Ohio.	Mi 113	Sept. 14, 1939	80	27.5	7.1	88.7	3.6	43	8.0	25	259	
Miami River, ¼ mile below Troy, Ohio.	Mi 112.8	Sept. 22, 1939	102	19.0	8.1	86.4	5.2	93	8.4	54		
Miami River, ½ mile below Troy, Ohio.	Mi 112.5	Sept. 18, 1939	100	21.5	11.4	127.6	8.4	240	8.3	20		
Miami River, upper edge, Tippecanoe City, Ohio.	Mi 105	Sept. 15, 1939		22.5	6.0	68.1	5.4	23	7.9	48	255	
Do	do	Sept. 18, 1939		19.5	10.5	113.6	6.0	91	8.1	42		

Miami River, bridge, Route 70, below Tippecanoe City, Ohio.	Mi 104	Sept. 15, 1939	----	24.0	4.6	54.4	4.5	460	7.8	37	260	----
Do	do	Sept. 18, 1939	----	19.5	7.8	84.7	5.5	1,100	8.1	40	----	----
Miami River, Needmore Road Bridge, above Dayton, Ohio.[1]	Mi 89.5	July 6, 1939	----	----	5.3	----	2.0	230	----	500	180	----
Do	do	July 13, 1939	----	23.3	6.5	75.3	1.3	23	----	100	250	----
Do	do	July 19, 1939	----	20.0	7.5	81.8	3.1	230	----	110	250	----
Do	do	July 28, 1939	----	25.5	7.9	95.2	4.2	230	----	50	250	----
Do	do	Aug. 3, 1939	----	22.8	6.2	71.2	4.0	23	----	80	180	----
Do	do	Aug. 9, 1939	----	23.3	7.2	83.4	7.3	230	----	95	250	----
Do	do	Aug. 17, 1939	----	24.4	7.2	85.0	5.6	230	----	30	280	----
Do	do	Aug. 24, 1939	----	22.2	5.7	64.8	2.3	2,300	----	50	230	----
Do	do	Aug. 31, 1939	----	21.7	9.6	108.1	4.0	230	----	90	300	----
Do	do	Sept. 7, 1939	----	23.3	8.5	98.5	5.3	230	----	95	260	----
Do	do	Sept. 14, 1939	----	23.9	9.1	106.5	8.3	23	----	90	280	----
Do	do	Sept. 21, 1939	----	19.4	6.9	74.4	5.4	0	----	70	260	----
Do	do	Sept. 28, 1939	----	17.2	8.7	89.7	5.3	0	----	55	260	----
Do	do	Oct. 12, 1939	----	16.0	8.3	----	3.2	0	----	60	260	----
Do	do	Oct. 19, 1939	----	12.0	9.7	----	3.4	23	----	25	290	----
Do	do	Oct. 26, 1939	----	14.0	7.7	----	3.6	23	----	40	280	----
Do	do	Nov. 2, 1939	----	7.0	8.6	----	4.3	230	----	25	260	----
Do	do	Nov. 9, 1939	----	4.0	10.4	----	3.3	230	----	15	260	----
Do	do	Nov. 15, 1939	----	6.0	9.6	----	2.5	23	----	10	280	----
Do	do	Nov. 24, 1939	----	5.0	9.3	----	2.2	23	----	25	300	----
Do	do	Nov. 30, 1939	----	3.0	10.9	----	2.7	23	----	10	260	----
Do	do	Dec. 7, 1939	----	4.0	11.5	----	3.9	230	----	25	250	----
Do	do	Dec. 12, 1939	----	3.0	9.2	----	.4	23	----	15	280	----
Do	do	Dec. 21, 1939	----	2.0	12.0	----	2.3	230	----	75	280	----
Do	do	Dec. 28, 1939	----	0	12.6	----	1.4	230	----	40	290	----
Miami River, New Troy Pike Bridge, above Dayton, Ohio.[1]	Mi 87	July 6, 1939	----	----	4.8	----	4.5	230	----	500	170	----
Do	do	July 13, 1939	----	23.3	6.8	78.8	.5	0	----	98	250	----
Do	do	July 19, 1939	----	21.1	7.6	84.6	2.8	230	----	100	250	----
Do	do	July 28, 1939	----	25.5	9.8	118.1	2.5	230	----	120	230	----
Do	do	Aug. 3, 1939	----	23.9	9.1	106.6	3.5	230	----	90	190	----
Do	do	Aug. 9, 1939	----	22.2	7.8	88.6	7.3	230	----	85	240	----
Do	do	Aug. 17, 1939	----	24.4	8.0	94.5	6.4	230	----	50	280	----
Do	do	Aug. 24, 1939	----	23.9	6.4	74.9	1.0	230	----	75	230	----
Do	do	Aug. 31, 1939	----	23.3	11.6	134.4	7.3	230	----	95	260	----
Do	do	Sept. 7, 1939	----	24.4	9.0	106.3	9.5	230	----	85	250	----
Do	do	Sept. 14, 1939	----	24.4	11.6	136.9	9.0	23	----	85	250	----
Do	do	Sept. 21, 1939	----	19.4	9.2	99.1	5.6	230	----	70	250	----
Do	do	Sept. 28, 1939	----	17.2	12.6	129.9	8.9	23	----	65	240	----
Do	do	Oct. 12, 1939	----	16.0	8.5	----	2.6	230	----	50	260	----
Do	do	Oct. 19, 1939	----	13.0	11.0	----	3.1	23	----	25	280	----
Do	do	Oct. 26, 1939	----	15.0	8.7	----	4.2	23	----	30	290	----
Do	do	Nov. 2, 1939	----	7.0	8.5	----	2.9	230	----	15	289	----
Do	do	Nov. 9, 1939	----	4.0	10.2	----	3.2	230	----	10	260	----
Do	do	Nov. 15, 1939	----	6.0	11.6	----	1.7	23	----	10	270	----
Do	do	Nov. 24, 1939	----	5.0	9.3	----	2.7	0	----	20	290	----
Do	do	Nov. 30, 1939	----	4.0	10.8	----	2.7	0	----	10	260	----
Do	do	Dec. 7, 1939	----	4.0	11.6	----	2.1	23	----	10	250	----

[1] Results submitted by Dayton sewage treatment plant.

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Miami River, New Troy Pike Bridge, above Dayton, Ohio.[1]	Mi 87	Dec. 14, 1939		2.0	11.7		3.7	23		10	280	
Do	do	Dec. 21, 1939		2.0	12.6		2.3	230		50	300	
Do	do	Dec. 28, 1939		0	12.3		.5	23		25	280	
Stillwater River, ¼ mile above Covington, Ohio.	MiSt 120	Sept. 15, 1939		23.0	5.5	63.2	2.2	2	8.0	51	292	
Do	do	Sept. 20, 1939		15.0	6.4	63.5	2.1	24	8.0	70		
Dismal Creek, below sewage, below Union City, Ohio.	MiStGD 154	Aug. 15, 1939	2	28.0	6.3	79.4	4.8	460	7.8	10	236	264
Do	do	Aug. 22, 1939	1	20.5	.8	9.3	9.1	11,000	7.9	8	402	
Do	do	Aug. 29, 1939	1	24.0	1.6	18.3	13.2	46,000	7.7	12	379	
Greenville Creek, 1 mile west of Greenville, Ohio.	MiStG 140	Sept. 13, 1939		19.5	6.1	65.7	2.9	15	8.0	37	282	
Do	do	Sept. 20, 1939		15.0	6.9	67.6	3.4	23	8.1	49		
Do	do	Sept. 25, 1939		19.0	9.2	98.9	3.4	43	8.2	28	290	
Greenville Creek, 1¼ miles east, bridge, U. S. 36, Greenville, Ohio.	MiStG 138	Sept. 13, 1939		20.0	3.8	41.8	4.2	11,000	7.8	25	269	
Do	do	Sept. 20, 1939		15.5	3.7	36.4	5.1	2,300	7.8	49		
Do	do	Sept. 25, 1939		20.5	5.8	64.3	2.3	360	7.8	37	270	
Stillwater River, 1 mile below Covington, Ohio.	MiSt 118	Sept. 15, 1939		23.0	3.2	37.2	2.7	2,900	7.8	28	274	
Do	do	Sept. 20, 1939		17.0	4.8	49.7	2.1	910	7.9	33		
Stillwater River, ½ mile above West Milton, Ohio.	MiSt 104	Sept. 15, 1939		22.5	8.2	93.1	3.0	23	8.0	37	243	
Do	do	Sept. 20, 1939		18.5	7.1	75.4	3.0	46	8.1	58		
Stillwater River, ¾ mile below West Milton, Ohio.	MiSt 103	Sept. 15, 1939		22.5	6.9	78.6	3.0	93	7.9	51	255	
Do	do	Sept. 20, 1939		19.5	7.6	82.2	4.2	93	7.9	64		
Stillwater River, Siebenthaler Bridge, above Dayton, Ohio.[1]	MiSt 89.5	July 6, 1939			7.5		2.1	0		15	280	
Do	do	July 13, 1939		24.4	7.0	82.6	.7	0		10	240	
Do	do	July 19, 1939		21.1	7.3	81.3	2.1	23		90	250	
Do	do	July 28, 1939		25.5	7.6	91.6	2.1	230		50	230	
Do	do	Aug. 3, 1939		23.3	7.3	84.6	1.5	23		85	210	
Do	do	Aug. 9, 1939		24.4	7.6	89.7	7.3	230		87	270	
Do	do	Aug. 17, 1939		24.4	8.2	96.8	4.4	23		30	240	
Do	do	Aug. 24, 1939		23.9	9.4	110.1	1.0	0		35	240	
Do	do	Aug. 31, 1939		22.8	8.9	102.2	2.5	230		25	250	
Do	do	Sept. 7, 1939		26.1	7.5	91.5	5.8	23		60	260	
Do	do	Sept. 14, 1939		24.4	7.4	87.4	Lost	23		30	260	

Do	do	Sept. 21, 1939		19.4	7.7	83.0	2.9	23		15	240	
Do	do	Sept. 28, 1939		17.2	7.9	81.4	2.7	0		25	270	
Do	do	Oct. 12, 1939		15.0	6.9		.9	0		50	250	
Do	do	Oct. 19, 1939		13.0	10.2		4.1	23		15	280	
Do	do	Oct. 26, 1939		15.0	10.2		5.2	0		15	250	
Do	do	Nov. 2, 1939		7.0	10.6		2.4	0		15	290	
Do	do	Nov. 9, 1939		4.0	11.3		3.2	230		0	260	
Do	do	Nov. 15, 1939		6.0	11.6		2.1	0		10	260	
Do	do	Nov. 24, 1939		5.0	11.8		2.4	23		10	260	
Do	do	Nov. 30, 1939		4.0	10.4		1.2	0		10	260	
Do	do	Dec. 7, 1939		5.0	12.9		2.7	2		10	270	
Do	do	Dec. 14, 1939		3.0	12.4		1.7	23		10	270	
Do	do	Dec. 21, 1939		1.0	13.0		1.8	23		25	270	
Do	do	Dec. 28, 1939		0	13.5		.6	2		25	280	
Stillwater River, Peter's Pike Bridge, above Dayton, Ohio.[1]	MiSt 86.0	July 6, 1939			6.4		1.7	230		15	270	
Do	do	July 13, 1939		23.3	6.5	75.3	1.0	230		10	250	
Do	do	July 19, 1939		21.1	7.0	78.0	2.4	23		110	250	
Do	do	July 28, 1939		25.5	7.0	84.3	Depl.	23		25	240	
Do	do	Aug. 3, 1939		22.2	6.4	72.7	3.0	23		100	190	
Do	do	Aug. 9, 1939		23.3	6.8	86.2	7.7	230		85	260	
Do	do	Aug. 17, 1939		24.4	7.3	86.2	3.6	23		50	260	
Do	do	Aug. 24, 1939		23.9	7.4	86.7	1.3	23		35	260	
Do	do	Aug. 31, 1939		21.7	7.8	87.8	4.0	23		85	260	
Do	do	Sept. 7, 1939		24.4	7.5	88.5	2.3	230		100	270	
Do	do	Sept. 14, 1939		23.3	7.1	82.3	2.8	23		30	260	
Do	do	Sept. 21, 1939		17.8	6.8	71.0	2.2	230		20	250	
Do	do	Sept. 28, 1939		21.1	7.7	85.7	2.0	230		10	300	
Do	do	Oct. 12, 1939		15.0	7.9		2.6	230		90	240	
Do	do	Oct. 19, 1939		13.0	10.1		3.0	2		30	260	
Do	do	Oct. 26, 1939		14.0	8.5		3.9	0		30	250	
Do	do	Nov. 2, 1939		7.0	10.2		2.2	230		15	280	
Do	do	Nov. 9, 1939		3.0	11.6		1.7	23		15	270	
Do	do	Nov. 15, 1939		6.0	10.9		1.8	0		10	260	
Do	do	Nov. 24, 1939		5.0	11.1		1.8	23		10	270	
Do	do	Nov. 30, 1939		4.0	11.3		1.7	23		15	270	
Do	do	Dec. 7, 1939		3.0	12.3		1.9	23		10	260	
Do	do	Dec. 14, 1939		2.0	13.5		4.0	0		10	280	
Do	do	Dec. 21, 1939		2.0	12.7		1.9	23		25	270	
Do	do	Dec. 28, 1939		1.0	13.0		.7	23		25	280	
Mad River, bridge, U. S. 36, above Urbana, Ohio.	MiM 127	Sept. 14, 1939		20.0	8.9	97.5	1.4	15	7.9	10	299	
Do	do	Sept. 18, 1939		13.5	8.5	80.7	1.4	15	7.9	18		
Mad River, ¼ mile from Route O-55, below Urbana, Ohio.	MiM 125	Sept. 14, 1939		21.5	7.9	89.0	2.6	430	7.9	10	303	
Do	do	Sept. 18, 1939		13.5	8.6	81.9	1.9	7	7.8	10		
Mad River, bridge, Route 70, above Springfield, Ohio.	MiM 112	Sept. 12, 1939		18.5	8.3	87.8	2.4	210	7.8	25	248	
Do	do	Sept. 18, 1939		14.0	8.0	77.0	1.9	210	8.0	10		
Do	do	Sept. 22, 1939		12.0	8.4	77.7	2.0	36	7.9	5	250	

[1] Results submitted by Dayton sewage treatment plant.

TABLE MI–7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Mad River, ¼ mile south, off Route 40, below Springfield, Ohio.	MiM 111	Sept. 12, 1939	...	18.5	6.1	64.8	4.1	240	7.8	30	289	...
Do	do	Sept. 18, 1939	...	16.0	5.3	53.1	4.4	230	7.6	43	...	...
Mad River, 1 mile south off Route 40, below Springfield, Ohio.	MiM 110.5	Sept. 12, 1939	199	18.0	5.6	58.7	3.8	1,100	7.8	52	293	...
Mad River, bridge on Route 40, below Springfield, Ohio.	MiM 110	Sept. 12, 1939	190	16.0	8.4	84.2	2.4	460	7.8	10	287	...
Mad River, Harshmanville Bridge, Dayton, Ohio.[1]	MiM 85	July 6, 1939	...	...	6.6	...	5.3	230	...	100	270	...
Do	do	July 13, 1939	...	21.1	6.3	70.2	2.1	230	...	90	300	...
Do	do	July 19, 1939	...	21.1	7.8	86.9	2.8	230	...	75	260	...
Do	do	July 28, 1939	...	22.2	9.2	104.5	2.3	23	...	10	270	...
Do	do	Aug. 3, 1939	...	23.3	6.5	75.3	4.0	23	...	85	290	...
Do	do	Aug. 9, 1939	...	21.1	7.9	88.0	6.8	230	...	85	300	...
Do	do	Aug. 17, 1939	...	22.8	9.3	106.8	4.0	23	...	25	300	...
Do	do	Aug. 24, 1939	...	20.0	9.1	99.2	.8	23	...	25	290	...
Do	do	Aug. 31, 1939	...	20.0	10.9	118.9	2.3	23	...	25	270	...
Do	do	Sept. 7, 1939	...	22.2	10.4	118.2	1.3	230	...	20	310	...
Do	do	Sept. 14, 1939	...	21.1	9.8	104.3	2.3	0	...	15	309	...
Do	do	Sept. 21, 1939	...	18.3	8.4	88.6	1.0	23	...	0	300	...
Do	do	Sept. 28, 1939	...	16.1	9.2	92.7	1.8	23	...	15	280	...
Do	do	Oct. 12, 1939	...	15.0	8.3	...	1.4	23	...	0	280	...
Do	do	Oct. 19, 1939	...	12.0	13.0	...	4.1	23	...	0	300	...
Do	do	Oct. 26, 1939	...	14.0	6.7	...	Lost	230	...	40	180	...
Do	do	Nov. 2, 1939	...	7.0	10.4	...	2.0	0	...	10	310	...
Do	do	Nov. 9, 1939	...	5.0	12.1	...	1.8	23	...	0	310	...
Do	do	Nov. 15, 1939	...	5.0	11.0	...	1.7	23	...	15	310	...
Do	do	Nov. 24, 1939	...	6.0	11.6	...	1.8	23	...	15	280	...
Do	do	Nov. 30, 1939	...	6.0	9.6	...	2.4	0	...	10	310	...
Do	do	Dec. 7, 1939	...	5.0	11.8	...	1.9	230	...	10	300	...
Do	do	Dec. 14, 1939	...	4.0	10.7	...	2.0	23	...	10	280	...
Do	do	Dec. 21, 1939	...	3.0	12.3	...	1.2	230	...	85	310	...
Do	do	Dec. 28, 1939	...	2.0	11.8	...	.4	2,300	...	25	290	...
Wolf Creek, Gettysburg Bridge, Dayton, Ohio.[1]	MiW 85	July 6, 1939	...	...	6.5	...	.2	0	...	10	250	...
Do	do	July 13, 1939	...	21.7	6.7	75.4	.2	0	...	90	260	...
Do	do	July 19, 1939	...	20.0	6.6	72.0	1.7	23	...	125	220	...
Do	do	July 28, 1939	...	23.3	6.3	73.0	1.3	230	...	90	240	...

Do	do	Aug. 3, 1939		22.8	6.9	79.2	4.0	230		50	190	
Do	do	Aug. 9, 1939		22.2	6.4	72.7	3.5	23		25	240	
Do	do	Aug. 17, 1939		22.8	6.7	76.9	2.0	23		25	240	
Do	do	Aug. 24, 1939		20.0	6.8	74.2	1.0	230		25	220	
Do	do	Aug. 31, 1939		21.1	7.0	78.0	.8	230		65	260	
Do	do	Sept. 7, 1939		21.7	7.1	80.0	.5	230		50	240	
Do	do	Sept. 14, 1939		23.3	7.1	82.3	1.0	230		25	240	
Do	do	Sept. 21, 1939		17.8	7.2	75.2	1.0	23		10	260	
Do	do	Sept. 28, 1939		21.1	6.7	74.6	2.1	23		50	250	
Do	do	Oct. 12, 1939		15.0	6.6		.6	0		10	250	
Do	do	Oct. 19, 1939		13.0	8.1		1.5	23		30	270	
Do	do	Oct. 26, 1939		14.0	8.0		2.0	23		30	250	
Do	do	Nov. 2, 1939		8.0	9.2		1.3	23		25	270	
Do	do	Nov. 9, 1939		5.0	10.0		.6	23		10	270	
Do	do	Nov. 15, 1939		6.0	11.4		1.8	23		15	280	
Do	do	Nov. 24, 1939		6.0	10.0		1.6	0		10	260	
Do	do	Nov. 30, 1939		6.0	9.2		.9	0		25	270	
Do	do	Dec. 7, 1939		4.0	10.6		1.5	23		25	250	
Do	do	Dec. 14, 1939		3.0	12.5		2.6	0		20	270	
Do	do	Dec. 21, 1939		3.0	12.0		1.1	23		50	280	
Do	do	Dec. 28, 1939		2.0	12.0		.9	0		30	280	
Miami River, Broadway St. Bridge, Dayton, Ohio.[1]	Mi 83	June 14, 1939	1,340	17.8	8.0		3.9					
Do	do	June 28, 1939	1,960	24.4	7.8		2.0				288	
Do	do	July 5, 1939	1,250	23.3	7.4		7.0				290	
Do	do	July 12, 1939	930	23.3	7.4		6.0				250	
Do	do	July 20, 1939	930	21.1	7.5		3.0				240	
Do	do	July 26, 1939	612		6.2		2.5				250	
Do	do	Aug. 4, 1939	1,480	23.3	7.1		7.5				210	
Do	do	Aug. 10, 1939	612	23.3	7.2		7.7				240	
Do	do	Aug. 16, 1939	505	24.4	6.3		3.2				260	
Do	do	Aug. 23, 1939	612	21.7	6.8		3.5				250	
Do	do	Aug. 30, 1939	400	26.7	6.8		7.8				230	
Do	do	Sept. 6, 1939	400	27.2	6.1		3.3				240	
Do	do	Sept. 13, 1939	340	25.0	5.8		8.3				250	
Do	do	Sept. 20, 1939	297	24.4	6.9		6.0				250	
Do	do	Sept. 27, 1939	215	21.1	7.2		4.0				260	
Do	do	Oct. 4, 1939	255	18.3	8.1		5.0				240	
Do	do	Oct. 11, 1939	255	22.2	6.0		4.8				250	
Do	do	Oct. 18, 1939	255	14.4	10.7		6.5				250	
Do	do	Oct. 27, 1939	865	19.4	6.8		4.9				230	
Do	do	Nov. 1, 1939	560	10.0	9.3		4.1				260	
Do	do	Nov. 8, 1939	380	3.9	10.1		6.5				270	
Do	do	Nov. 16, 1939	340	3.3	10.1		5.7				280	
Do	do	Nov. 22, 1939	420	3.3	10.0		5.1				260	
Do	do	Nov. 29, 1939	505	6.7	13.1		4.8				260	
Do	do	Dec. 6, 1939	463	6.7	12.2		5.3				260	
Do	do	Dec. 13, 1939	360	7.8	11.2		5.1				260	
Do	do	Dec. 20, 1939	380	8.9	10.5		4.8				270	

[1] Results submitted by Dayton sewage treament plant.

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Miami River, ½ mile below sewer, Dayton, Ohio.[1]	Mi 82	June 14, 1939		18.3	7.7		5.4					
Do	do	June 28, 1939		24.4	7.6		1.6				323	
Do	do	July 5, 1939		23.3	7.2		8.3				310	
Do	do	July 12, 1939		23.3	7.2		3.5				330	
Do	do	July 20, 1939		21.1	7.3		12.8				320	
Do	do	July 26, 1939			6.5		2.2				270	
Do	do	Aug. 4, 1939		23.3	6.9		8.0				230	
Do	do	Aug. 10, 1939		23.3	7.1		11.5				280	
Do	do	Aug. 16, 1939		23.9	6.3		4.4				280	
Do	do	Aug. 23, 1939		22.2	6.6		3.3				280	
Do	do	Aug. 30, 1939		26.1	6.7		9.3				280	
Do	do	Sept. 6, 1939		27.8	6.4		3.8				270	
Do	do	Sept. 13, 1939		25.0	7.9		13.0				290	
Do	do	Sept. 20, 1939		23.3	7.3		10.8				300	
Do	do	Sept. 27, 1939		20.6	7.1		12.5				310	
Do	do	Oct. 4, 1939		18.3	6.6		8.5				270	
Do	do	Oct. 11, 1939		20.6	5.9		5.8				280	
Do	do	Oct. 18, 1939		14.4	9.6		9.2				290	
Do	do	Oct. 27, 1939		19.4	6.2		11.0				270	
Do	do	Nov. 1, 1939		13.3	8.4		8.0				300	
Do	do	Nov. 8, 1939		11.7	8.7		3.6				310	
Do	do	Nov. 16, 1939		8.9	9.3		4.0				300	
Do	do	Nov. 22, 1939		10.6	9.9		4.2				270	
Do	do	Nov. 29, 1939		10.0	11.0		8.1				270	
Do	do	Dec. 6, 1939		10.0	10.2		7.4				280	
Do	do	Dec. 13, 1939		10.0	9.8		8.4				280	
Do	do	Dec. 20, 1939		10.0	9.3		8.7				290	
Maimi River, 2½ miles below sewer, Dayton, Ohio.[1]	Mi 80	June 14, 1939		18.3	7.6		4.2					
Do	do	June 28, 1939		24.4	7.8		2.0				350	
Do	do	July 5, 1939		23.3	7.0		9.5				310	
Do	do	July 12, 1939		23.3	7.2		3.8				260	
Do	do	July 20, 1939		21.1	7.2		5.0				250	
Do	do	July 26, 1939			5.6		2.2				250	
Do	do	Aug. 4, 1939		23.3	6.8		6.8				230	
Do	do	Aug. 10, 1939		23.3	6.7		7.7				270	
Do	do	Aug. 16, 1939		24.4	6.2		3.2				270	
Do	do	Aug. 23, 1939		22.2	6.4		4.5				260	

Do	do	Aug. 30, 1939		26.1	6.8		8.0				280	
Do	do	Sept. 6, 1939		26.1	5.3		5.3				250	
Do	do	Sept. 13, 1939		23.3	5.9		8.0				260	
Do	do	Sept. 20, 1939		23.3	6.3		7.8				270	
Do	do	Sept. 27, 1939		20.6	6.5		5.0				270	
Do	do	Oct. 4, 1939		17.2	7.5		6.0				260	
Do	do	Oct. 11, 1939		21.1	5.0		5.3				270	
Do	do	Oct. 18, 1939		13.3	9.2		4.7				280	
Do	do	Oct. 27, 1939		18.3	6.4		4.4				240	
Do	do	Nov. 1, 1939		10.0	8.9		2.6				280	
Do	do	Nov. 8, 1939		7.2	9.4		4.1				290	
Do	do	Nov. 16, 1939		7.8	9.9		4.2				290	
Do	do	Nov. 22, 1939		7.8	9.6		4.6				270	
Do	do	Nov. 29, 1939		5.6	11.0		3.9				260	
Do	do	Dec. 6, 1939		6.7	10.6		3.3				270	
Do	do	Dec. 13, 1939		7.8	9.6		4.7				260	
Do	do	Dec. 20, 1939		8.9	9.0		3.7				280	
Miami River, 5 miles below sewer, Dayton, Ohio.[1]	Mi 77.5	June 14, 1939		17.8	7.5		3.8					
Do	do	June 28, 1939		24.4	7.3		1.8				300	
Do	do	July 5, 1939		23.3	6.9		9.7				315	
Do	do	July 12, 1939		23.3	7.2		6.8				260	
Do	do	July 20, 1939		21.1	7.0		5.3				260	
Do	do	July 26, 1939			5.5		2.5				270	
Do	do	Aug. 4, 1939		23.3	6.5		7.3				210	
Do	do	Aug. 10, 1939		23.3	6.6		6.2				260	
Do	do	Aug. 16, 1939		24.4	5.8		5.2				270	
Do	do	Aug. 23, 1939		22.2	6.2		5.8				250	
Do	do	Aug. 30, 1939		26.1	7.1		8.3				260	
Do	do	Sept. 6, 1939		26.1	4.5		6.5				260	
Do	do	Sept. 13, 1939		23.3	4.5		6.0				270	
Do	do	Sept. 20, 1939		23.3	5.2		6.0				290	
Do	do	Sept. 27, 1939		20.6	4.9		4.8				280	
Do	do	Oct. 4, 1939		17.2	6.6		8.3				250	
Do	do	Oct. 11, 1939		21.1	4.3		3.0				280	
Do	do	Oct. 18, 1939		13.3	7.7		3.6				280	
Do	do	Oct. 27, 1939		18.3	6.6		4.5				240	
Do	do	Nov. 1, 1939		9.4	8.9		3.4				290	
Do	do	Nov. 8, 1939		9.4	9.1		3.5				290	
Do	do	Nov. 16, 1939		8.3	10.2		4.2				290	
Do	do	Nov. 22, 1939		7.8	9.2		4.4				260	
Do	do	Nov. 29, 1939		6.7	10.8		3.2				260	
Do	do	Dec. 6, 1939		5.6	10.5		3.3				260	
Do	do	Dec. 13, 1939		7.8	9.9		4.9				270	
Do	do	Dec. 20, 1939		8.9	9.3		4.6				280	
Miami River, 6 miles below sewer, Dayton, Ohio.[1]	Mi 76.5	June 14, 1939		18.3	7.1		4.6					
Do	do	June 28, 1939		24.4	6.9		2.0				337	
Do	do	July 5, 1939		23.3	6.7		6.8				320	
Do	do	July 12, 1939		23.3	6.8		5.0				260	
Do	do	July 20, 1939		21.1	7.0		5.0				250	

[1] Results submitted by Dayton sewage treatment plant.

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Miami River, 6 miles below sewer, Dayton, Ohio.[1]	Mi 76.5	July 26, 1939			5.7		3.0				270	
Do	do	Aug. 4, 1939		23.3	6.4		4.2					
Do	do	Aug. 10, 1939		23.9	6.7		6.2				260	
Do	do	Aug. 16, 1939		25.6	5.4		6.4				280	
Do	do	Aug. 23, 1939		23.3	6.1		3.8				260	
Do	do	Aug. 30, 1939		26.1	5.7		5.3				260	
Do	do	Sept. 6, 1939		26.1	5.6		3.3				250	
Do	do	Sept. 13, 1939		23.3	5.2		7.3				260	
Do	do	Sept. 20, 1939		23.3	6.2		5.8				280	
Do	do	Sept. 27, 1939		20.6	6.3		4.0				270	
Do	do	Oct. 4, 1939		17.2	6.3		8.0				250	
Do	do	Oct. 11, 1939		21.1	4.3		2.0				270	
Do	do	Oct. 18, 1939		13.3	8.2		5.6				270	
Do	do	Oct. 27, 1939		18.3	6.9		4.0				240	
Do	do	Nov. 1, 1939		10.0	8.5		3.2				270	
Do	do	Nov. 8, 1939		9.4	8.5		3.5				280	
Do	do	Nov. 16, 1939		8.9	11.2		5.6				280	
Do	do	Nov. 22, 1939		8.9	8.8		4.4				260	
Do	do	Nov. 29, 1939		6.7	10.9		4.0				260	
Do	do	Dec. 6, 1939		6.1	10.3		4.1				260	
Do	do	Dec. 13, 1939		7.8	10.4		4.1				260	
Do	do	Dec. 20, 1939		8.9	10.0		5.8				280	
Miami River, 7½ miles below Dayton sewage, West Carrollton, Ohio.[1]	Mi 75	June 14, 1939		17.8	7.1		6.0					
Do	do	June 28, 1939		25.6	6.9		2.3				288	
Do	do	July 5, 1939		23.3	6.4		13.5				320	
Do	do	July 12, 1939		23.3	6.7		5.0				270	
Do	do	July 20, 1939		21.1	6.9		7.0				250	
Do	do	July 26, 1939		13.9	6.2		2.7				260	
Do	do	Aug. 4, 1939		23.3	6.3		5.3				210	
Do	do	Aug. 10, 1939		24.4	6.4		9.7				260	
Do	do	Aug. 16, 1939		25.0	5.5		6.8				230	
Do	do	Aug. 23, 1939		23.3	6.2		4.5				260	
Do	do	Aug. 30, 1939		26.1	5.5		7.0				280	
Do	do	Sept. 6, 1939		26.1	6.1		6.0				250	
Do	do	Sept. 13, 1939		23.3	6.0		7.5				260	
Do	do	Sept. 20, 1939		23.3	6.2		5.8				280	
Do	do	Sept. 27, 1939		26.1	6.6		6.3				280	

Do	*do*	*Oct. 4, 1939*		17.2	7.0		7.8					260	
Do	*do*	*Oct. 11, 1939*		21.1	4.9		6.5					270	
Do	do	Oct. 18, 1939		12.8	9.3		4.7					270	
Do	do	Oct. 27, 1939		18.3	6.6		4.8					240	
Do	do	Nov. 1, 1939		10.0	8.3		3.0					280	
Do	do	Nov. 8, 1939		9.4	8.0		2.9					290	
Do	do	Nov. 16, 1939		8.9	10.6		4.7					280	
Do	do	Nov. 22, 1939		8.9	8.7		4.2					260	
Do	do	Nov. 29, 1939		6.7	11.4		5.3					260	
Do	do	Dec. 6, 1939		6.7	10.8		4.0					260	
Do	do	Dec. 13, 1939		7.8	11.8		5.0					260	
Do	do	Dec. 20, 1939		8.9	9.7		5.8					280	
Miami River, above Miamisburg, Ohio.	Mi 71.6	June 20, 1939		22.5	7.6	87.0	3.8	930					
Do	do	June 27, 1939		25.0	7.5	89.5	2.5	230					
Do	do	July 11, 1939		25.0	7.3	87.4	1.9	930					
Do	do	July 20, 1939		22.5	7.3	83.8	2.2	2,400					
Do	do	Aug. 3, 1939		24.5	7.2	85.7	1.9	230					
Do	do	Aug. 17, 1939		26.5	6.8	83.9	3.0	91	8.0				
Do	do	Aug. 31, 1939		23.5	9.0	104.1	3.5	140	8.1				
Do	do	Sept. 14, 1939		24.5	7.4	87.0	3.3	110	8.0				
Do	do	Sept. 28, 1939		21.0	9.5	105.7	4.0	460	8.2				
Do	do	Oct. 12, 1939		18.5	6.4	68.1	2.4	930	7.8				
Do	do	Oct. 26, 1939		17.0	7.4	75.6	4.1	430	8.0				
Do	do	Nov. 9, 1939	410	8.5	11.7	99.6	2.2	390	7.6				
Do	do	Dec. 6, 1939		7.5	11.8	97.8	2.2	150					
Do	do	Dec. 20, 1939		7.0	9.6	78.6	2.7	36	7.8				
Do	do	Jan. 5, 1940		1.0	13.4	94.0	3.7	91	7.9				
Do	do	Jan. 17, 1940		0.0	13.6	92.9	4.5	930	7.6				
Do	do	Feb. 2, 1940		2.0	11.7	84.7	3.2	91	8.1				
Do	do	Feb. 12, 1940		3.0	12.8	95.0	6.6	430	7.6				
Do	do	Feb. 19, 1940		3.5	12.7	95.5	4.6	1,100	7.8				
Do	do	Feb. 26, 1940		3.0	13.2	98.1	1.9	93	8.0				
Do	do	Mar. 1, 1940		6.0	12.7	101.4	2.7	93					
Do	do	Mar. 7, 1940		5.5	12.5	98.9	1.4	93	7.7				
Do	do	Mar. 13, 1940		6.5	11.8	95.9	4.6	1,100	7.8				
Do	do	Mar. 20, 1940		8.5	10.5	89.5	2.4	91	8.0				
Do	do	Mar. 28, 1940		10.0	11.3	99.7	2.8	91	8.0				
Do	do	Apr. 5, 1940		15.0	9.9	97.5	2.8	23	8.1				
Miami River, bridge in town, Miamisburg, Ohio.	Mi 69.0	Feb. 21, 1939		5.0	11.6	90.2	3.8	1,100					
Do	do	Feb. 27, 1939		3.0	12.4	92.2	3.9	240					
Do	do	Mar. 3, 1939		2.5	12.8	93.9	2.7	150					
Do	do	Mar. 7, 1939		5.5	12.4	97.7	2.2	36					
Do	do	Mar. 10, 1939		6.0	11.1	88.9	4.5	1,100					
Do	do	Mar. 13, 1939		6.0	11.7	93.5	4.5	460					
Do	do	Mar. 15, 1939		8.0	11.2	94.0	2.8	240					
Do	do	Mar. 20, 1939		5.5	12.0	94.5	2.6	290					
Do	do	Mar. 23, 1939		9.0	10.5	90.3	5.0	1,100					
Do	do	Mar. 27, 1939		12.5	9.3	86.9	3.8	30					
Do	do	Mar. 31, 1939		7.0	11.1	91.3	3.7	460					

[1] Results submitted by Dayton sewage treatment plant.

TABLE MI–7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Miami River, bridge in town, Miamisburg, Ohio.	Mi 69.0	Apr. 4, 1939		9.5	10.4	90.5	4.8	43				
Do	do	Apr. 7, 1939		6.5	11.4	92.3	4.4	43				
Do	do	Apr. 10, 1939		10.0	10.7	94.3	3.2	93				
Do	do	Apr. 12, 1939		8.0	10.9	91.9	4.1	1,100				
Do	do	Apr. 17, 1939		10.0	10.8	95.2	3.6	93				
Do	do	Apr. 20, 1939		9.0	11.1	95.9	2.4	150				
Do	do	Apr. 26, 1939		16.5	8.4	84.9	3.5	1,100				
Do	do	Apr. 28, 1939		16.5	8.5	86.6	2.4	91				
Do	do	May 1, 1939		13.5	9.5	91.0	1.8	430				
Do	do	May 4, 1939		14.5	9.1	88.7	3.0	930				
Do	do	May 8, 1939		19.5	8.3	90.1	3.7	150				
Do	do	May 12, 1939		17.0	8.4	86.2	5.3	1,500				
Do	do	May 16, 1939		17.5	8.3	86.4	4.8	73				
Do	do	May 19, 1939		21.0	7.6	84.9	6.0	91				
Do	do	May 22, 1939		21.5	6.8	76.8	4.6	23				
Do	do	May 24, 1939		23.0	6.4	73.4	6.8	23				
Do	do	June 2, 1939		24.0	5.9	68.9	5.1	2,400				
Do	do	June 5, 1939		23.0	7.1	81.5	3.7	2,400				
Do	do	June 7, 1939		25.5	5.9	71.6	5.5	750				
Do	do	June 13, 1939		19.5	7.3	78.7	3.1	230				
Do	do	June 16, 1939		24.0	6.4	75.6	4.8	430				
Miami River, below Miamisburg, Ohio.	Mi 66.5	June 20, 1939		22.0	7.4	84.4	3.4	91				
Do	do	June 27, 1939		25.0	7.0	83.2	3.6	430				
Do	do	July 11, 1939		24.0	6.5	76.2	3.4	2,400				
Do	do	June 20, 1939		22.0	6.7	76.2	3.3	430	7.9			
Do	do	Aug. 3, 1939		24.5	6.4	76.0	2.4	430				
Do	do	Aug. 17, 1939		26.0	5.1	62.0	3.6	430	7.9			
Do	do	Aug. 31, 1939		23.5	5.2	61.0	5.0	1,500	7.9			
Do	do	Sept. 14, 1939		24.5	4.7	55.6	4.9	2,400	7.9			
Do	do	Sept. 28, 1939		20.5	5.8	64.0	6.7	11,000	8.0			
Do	do	Oct. 12, 1939		18.5	4.5	47.4	3.6	360	7.8			
Do	do	Oct. 26, 1939		17.0	5.4	55.9	5.0	910	7.7			
Do	do	Nov. 9, 1949	410	8.0	9.2	77.3	6.1	2,400	7.8			
Do	do	Dec. 6, 1939		6.5	11.5	93.6	5.6	930				
Do	do	Dec. 20, 1939		7.5	8.4	70.1	4.7	2,400	7.8			
Do	do	Jan. 5, 1940		1.0	11.8	83.1	6.4	750	7.8			
Do	do	Jan. 23, 1940		0	12.6	86.3	5.1	91				

Miami River bridge in Franklin, Ohio.	*Mi 61.3*	*June 20, 1939*		*22.5*	*8.0*	*90.9*	*3.9*	*2,400*				
Do	do	June 27, 1939		24.5	7.0	83.0	4.2	230				
Miami River, above Franklin, Ohio	Mi 62.8	July 11, 1939		23.5	7.5	86.9	2.8	230				
Do	do	July 20, 1939		22.0	7.6	85.6	3.1	430	8.2			
Do	do	Aug. 3, 1939		24.5	7.1	84.4	2.3	230				
Do	do	Aug. 17, 1939		26.5	7.5	92.1	4.2	36	8.0			
Do	do	Aug. 31, 1939		23.5	7.6	88.0	3.8	2,400	8.0			
Do	do	Sept. 14, 1939		22.5	7.4	84.0	4.1	110	7.9			
Do	do	Sept. 28, 1939		20.0	10.8	117.9	5.5	46	8.1			
Do	do	Oct. 12, 1939		18.0	7.2	75.8	3.5	230	7.8			
Do	do	Oct. 26, 1939		16.5	7.2	73.1	4.5	150	7.7			
Do	do	Nov. 9, 1939	420	7.5	9.0	74.6	3.3	750	7.6			
Do	do	Dec. 6, 1939		6.5	11.0	89.5	4.6	930				
Do	do	Dec. 20, 1939		7.0	8.3	68.4	3.5	150	7.6			
Do	do	Jan. 5, 1940		0	12.9	88.4	5.7	36	7.8			
Do	do	Jan. 23, 1940		0	13.4	91.9	2.8	230				
Miami River, below Franklin, Ohio	Mi 59.6	July 11, 1939		23.5	6.7	77.6	3.9	2,400				
Do	do	July 20, 1939		22.0	7.0	79.8	2.7	91	7.9			
Do	do	Aug. 3, 1939		25.5	6.3	75.9	3.1	11,000				
Do	do	Aug. 17, 1939		26.5	6.0	74.3	5.5	2,300	7.9			
Do	do	Aug. 31, 1939		24.0	7.0	82.4	5.8	910	7.9			
Do	do	Sept. 14, 1939		26.0	5.6	67.5	5.9	11,000	7.9			
Do	do	Sept. 28, 1939		19.0	6.8	72.2	8.9	11,000	7.9			
Do	do	Oct. 12, 1939		18.0	4.4	46.5	7.2	46,000	7.7			
Do	do	Oct. 26, 1939		16.5	4.1	41.6	8.5	3,600	7.6			
Do	do	Nov. 9, 1939	420	7.5	7.7	64.2	6.6	24,000	7.6			
Do	do	Dec. 6, 1939		5.5	9.8	77.2	6.2	24,000				
Do	do	Dec. 20, 1939		7.0	7.8	64.3	5.4	9,300	7.7			
Do	do	Jan. 5, 1940		0	18.6	127.1	18.2	46,000	7.8			
Do	do	Jan. 17, 1940		0	13.7	93.9	5.6	430	7.6			
Do	do	Jan. 23, 1940		0	13.1	89.4	4.0	360				
Do	do	Feb. 2, 1940		0	10.7	73.4	13.8	930	8.0			
Do	do	Feb. 26, 1940		3.0	13.2	98.1	3.6	150	8.0			
Do	do	Mar. 1, 1940		4.5	12.6	96.9	4.7	240				
Do	do	Mar. 7, 1940		4.0	12.6	95.9	3.5	240	7.8			
Do	do	Mar. 13, 1940		6.0	11.6	92.5	9.7	2,400	7.8			
Do	do	Mar. 20, 1940		10.0	10.2	90.0	7.3	930	8.0			
Do	do	Mar. 28, 1940		9.0	10.5	90.6	9.8	4,600	7.9			
Do	do	Apr. 5, 1940		13.5	8.6	81.7	6.2	910	8.0			
Twin Creek, above Germantown, Ohio.	MiT 68	Aug. 31, 1939	24	21.0	7.6	84.6	1.1	15	7.9			
Do	do	Sept. 28, 1939	12	17.0	8.4	86.8	.8	4	8.0			
Do	do	Oct. 26, 1939	28	15.0	8.0	78.4	1.6	43	7.9			
Do	do	Dec. 6, 1939		3.5	12.4	93.2	.9	4				
Do	do	Jan. 5, 1940		0	13.6	93.0	.2	5	7.8			
Twin Creek, below Germantown, Ohio.	MiT 65.5	Aug. 31, 1939	24	20.0	7.6	82.6	1.1	23	7.9			
Do	do	Sept. 28, 1939	12	16.0	8.4	83.9	1.3	24	7.9			
Do	do	Oct. 26, 1939	28	15.0	8.1	79.8	1.7	43	7.9			
Do	do	Dec. 6, 1939		4.5	12.4	95.8	1.0	23				
Do	do	Jan. 5, 1940		0	14.0	95.7	.4	8	7.8			

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Twin Creek, at mouth	MiT 59.9	Sept. 28, 1939	14	18.0	8.8	92.2	2.5	110	8.1			
Do	do	Oct. 12, 1939		15.0	8.8	86.7	1.1	23	7.9			
Do	do	Oct. 26, 1939		16.0	8.9	89.4	1.2	15	8.0			
Do	do	Nov. 9, 1939	21	5.5	12.3	97.6	.8	8	8.0			
Do	do	Dec. 6, 1939		4.0	12.7	96.7	.9	9				
Do	do	Dec. 20, 1939		5.0	10.6	82.5	.5	9	8.0			
Do	do	Jan. 5, 1940		0	13.9	95.1	.6	9	7.8			
Miami River, above Middletown, Ohio.	Mi 57	June 19, 1939		22.5	7.0	80.3	5.9	4,600				
Do	do	June 20, 1939		22.5	8.0	91.2	3.6	430				
Do	do	June 27, 1939		25.0	7.2	86.2	2.7	750				
Do	do	June 28, 1939		25.0	7.2	86.2	2.6	930				
Do	do	July 5, 1939		23.5	7.5	87.2	2.3	930				
Do	do	July 21, 1939		23.0	8.0	92.1	2.2	930	7.9			
Do	do	Aug. 4, 1939		23.5	7.0	82.0	2.4	150				
Do	do	Aug. 18, 1939		26.0	8.1	98.8	3.3	430	8.0			
Do	do	Sept. 1, 1939		22.5	7.2	82.6	4.0	430	8.1			
Do	do	Sept. 15, 1939		23.5	7.4	86.4	7.4	93	7.4			
Do	do	Sept. 29, 1939		20.5	12.1	132.9	6.7	36	7.9			
Do	do	Oct. 13, 1939		12.5	8.6	80.1	3.6	23	7.9			
Do	do	Oct. 27, 1939		18.5	7.7	82.0	2.6	230	7.7			
Do	do	Nov. 10, 1939	495	9.0	9.5	81.7	2.4	240	7.9			
Do	do	Dec. 7, 1939		5.5	11.1	87.7	3.2	1,100				
Do	do	Dec. 21, 1939		4.5	10.6	82.0	3.0	460	7.8		276	
Do	do	Jan. 8, 1940		1.0	10.6	74.7	2.7	43	7.6			
Do	do	Feb. 2, 1940		1.0	10.4	73.4	8.0	240	7.8			
Do	do	Feb. 12, 1940		2.5	12.1	88.6	6.3	430	7.6			
Do	do	Feb. 19, 1940		4.0	13.2	100.5	4.5	240	7.8			
Miami River, east of Trenton, below Middletown, Ohio.	Mi 50	Feb. 21, 1939		6.0	11.5	92.1	5.3	460				
Do	do	Feb. 27, 1939		3.5	12.7	95.2	3.1	240				
Do	do	Mar. 3, 1939		4.0	12.9	98.0	3.4	460				
Do	do	Mar. 7, 1939		7.0	12.0	98.6	4.6	460				
Do	do	Mar. 10, 1939		6.5	11.1	90.1	5.3	2,400				
Do	do	Mar. 13, 1939		7.5	11.9	99.0	4.7	240				
Do	do	Mar. 15, 1939		8.0	11.3	95.3	3.4	460				
Do	do	Mar. 20, 1939		6.5	12.1	98.1	2.8	1,100				
Do	do	Mar. 23, 1939		9.0	10.5	90.3	5.2	2,400				

Do	do	Mar. 27, 1939		11.5	9.4	85.4	5.4	1,500				
Do	do	Mar. 31, 1939			11.0		5.1	230				
Do	do	Apr. 4, 1939		9.5	10.4	90.3	4.5	390				
Do	do	Apr. 7, 1939		7.0	11.1	91.1	5.6	240				
Do	do	Apr. 10, 1939		10.5	11.0	98.3	2.6	93				
Do	do	Apr. 12, 1939		8.5	10.6	90.1	4.8	460				
Do	do	Apr. 17, 1939		11.0	10.8	97.4	3.9	240				
Do	do	Apr. 20, 1939		10.0	11.1	98.2	3.3	460				
Do	do	Apr. 26, 1939		17.0	8.4	85.8	4.0	930				
Do	do	Apr. 28, 1939		17.0	8.2	84.7	3.4	230				
Do	do	May 2, 1939		13.5	9.5	90.8	2.5	230				
Do	do	May 4, 1939		14.5	9.0	87.7	4.2	1,160				
Do	do	May 8, 1939		19.5	8.5	91.8	4.0	91				
Do	do	May 12, 1939		17.0	7.9	81.5	4.8	230				
Do	do	May 16, 1939		17.0	8.4	86.7	5.8	91				
Do	do	May 19, 1939		20.5	7.5	82.6	5.1	2,400				
Do	do	May 22, 1939		21.5	7.4	82.5	3.7	73				
Do	do	May 24, 1939		22.0	6.0	68.0	5.8	460				
Miami River-Trenton, Ohio, below Middletown.	Mi 50.8	June 2, 1939		24.5	6.4	75.7	6.6	230				
Do	do	June 5, 1939		23.0	6.7	77.6	4.0	750				
Do	do	June 7, 1939		25.5	6.2	74.2	6.0	750				
Do	do	June 13, 1939		18.5	6.8	72.4	6.8	4,600				
Do	do	June 16, 1939		24.0	6.5	75.8	4.4	430				
Do	do	June 19, 1939		23.0	6.1	70.3	6.5	2,400				
Do	do	June 28, 1939		25.5	6.2	74.6	3.7	430				
Do	do	July 5, 1939		23.5	6.8	79.0	2.6	2,400				
Do	do	July 21, 1939		23.0	6.4	74.1	3.5	930	7.6			
Do	do	Aug. 4, 1939		24.0	6.1	71.0	2.9	4,600				
Do	do	Aug. 18, 1939		26.5	5.2	63.9	5.5	1,500	7.9			
Do	do	Sept. 1, 1939		24.0	6.1	71.5	5.4	1,500	7.8			
Do	do	Sept. 15, 1939		26.0	4.1	49.9	6.7	430	7.7			
Do	do	Sept. 29, 1929		22.0	5.6	63.4	6.0	430	7.5			
Do	do	Oct. 13, 1939		17.0	4.8	49.7	7.6	930	7.6			
Do	do	Oct. 27, 1939		19.0	3.5	37.9	9.6	390				
Do	do	Nov. 10, 1939	495	10.0	7.9	69.5	6.9	930	7.7			
Do	do	Dec. 7, 1939		7.0	9.2	75.3	6.6	1,500				
Do	do	Dec. 21, 1939		5.5	7.4	58.5	5.8	430	7.2		244	
Do	do	Jan. 8, 1940		1.5	10.6	75.8	5.7	1,100	7.3			
Do	do	Jan. 17, 1940		0	13.4	91.7	7.5	930	7.5			
Do	do	Feb. 12, 1940		3.5	13.1	98.8	6.4	150	7.5			
Do	do	Feb. 19, 1940		6.0	13.1	105.0	5.2	460	7.8			
Do	do	Feb. 26, 1940		3.5	12.5	94.2	3.1	240	7.6			
Do	do	Mar. 1, 1940		9.0	11.6	99.9	5.4	460				
Do	do	Mar. 7, 1940		6.5	11.7	94.9	3.2	1,100	7.5			
Do	do	Mar. 13, 1940		7.0	10.8	88.3	5.8	1,100	7.5			
Do	do	Mar. 20, 1940		10.5	10.2	91.3	4.9	2,400	7.9			
Do	do	Mar. 28, 1940		10.0	10.7	94.4	6.0	4,600	7.9			
Do	do	Apr. 5, 1940		13.0	8.5	80.0	6.0	430	7.8			

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
7 Mile Creek, above Eaton, Ohio	MiS 67	Aug. 24, 1939		21.0	9.6	108.3	.7	93	8.1			
Do	do	Sept. 21, 1939		17.0	8.6	88.4	1.1	24	7.8			
Do	do	Oct. 19, 1939		11.5	9.4	86.1	1.1	24	7.9			
Do	do	Nov. 16, 1939		6.0	12.0	96.6	.5	24	7.9			
Do	do	Dec. 28, 1939		1.0	13.5	94.7	.4	2	7.8			
Do	do	Jan. 26, 1940		0	12.9	88.1	.8	4	7.6			
7 Mile Creek, below Eaton, Ohio	MiS 65.5	Aug. 24, 1939		22.5	11.0	125.1	1.7	150	7.5			
Do	do	Sept. 21, 1939		18.5	9.4	99.9	1.7	93	8.1			
Do	do	Oct. 19, 1939		10.5	10.4	92.9	.9	93	7.9			
Do	do	Nov. 16, 1939		4.5	14.4	110.9	.3	43	8.2			
Do	do	Dec. 28, 1939		1.0	10.5	74.0	5.0	2,400	7.9			
Do	do	Jan. 26, 1940		0	10.3	70.5	5.5	1,100	7.6			
Four Mile Creek, above Oxford, Ohio	MiF 55.5	Aug. 24, 1939		20.0	8.2	89.6	.8	7	8.1			
Do	do	Sept. 21, 1939		15.5	5.8	57.3	1.0	110	7.5			
Do	do	Oct. 19, 1939		11.0	6.7	60.5	1.0	2	7.5			
Do	do	Nov. 16, 1939		3.0	10.6	78.3	1.3	24	7.7			
Do	do	Dec. 28, 1939		0	12.3	84.4	.9	30	7.7			
Do	do	Jan. 26, 1940		0	12.6	86.2	5.3	4	7.6			
Four Mile Creek, below Oxford, Ohio	MiF 54	Aug. 24, 1939		20.5	8.0	88.1	1.2	240	8.0			
Do	do	Sept. 21, 1939		18.5	8.7	91.9	3.4	23	8.2			
Do	do	Oct. 19, 1939		10.0	9.5	83.9	2.0	15	7.9			
Do	do	Nov. 16, 1939		2.5	10.5	76.6	2.0	110	7.7			
Do	do	Dec. 28, 1939		0	12.3	84.2	1.0	9	7.9			
Do	do	Jan. 26, 1940		0	10.7	73.1	2.8	1,100	7.6			
Seven Mile Creek, at mouth	MiS 39	Sept. 29, 1939		19.5	7.9	85.0	.6	4	7.7			
Do	do	Oct. 13, 1939		13.0	8.5	80.5	.5	24	7.8			
Do	do	Oct. 27, 1939		19.0	8.1	86.6	4.9	240	7.9			
Do	do	Nov. 10, 1939		9.5	10.6	92.8	.9	4	7.8			
Do	do	Dec. 7, 1939		5.0	11.3	88.5	0.6	4				
Do	do	Dec. 21, 1939		3.5	11.8	88.4	0.8	1	7.6			
Do	do	Jan. 8, 1940		1.5	11.9	85.0	0.4	(2)	7.7			
Do	do	Jan. 26, 1940		0	13.0	88.9	2.4	11	7.7			
Miami River, bridge at New Miami, above Hamilton, Ohio.	Mi 38.3	Feb. 21, 1939		5.5	11.4	90.1	6.0	460				
Do	do	Feb. 27, 1939		3.0	12.8	94.7	3.3	240				
Do	do	Mar. 3, 1939		3.5	13.0	97.7	3.7	240				
Do	do	Mar. 7, 1939		7.0	12.0	98.6	4.4	240				
Do	do	Mar. 10, 1939		7.0	11.2	92.2	4.1	460				
Do	do	Mar. 13, 1939		7.0	11.6	95.1	5.1	460				
Do	do	Mar. 15, 1939		8.0	11.2	94.6	3.2	1,100				

Do	do	Mar. 20, 1939		6.0	12.2	97.4	2.2	150				
Do	do	Mar. 23, 1939		9.0	10.7	92.2	4.5	1,100				
Do	do	Mar. 27, 1939		11.0	9.6	86.7	3.0	36				
Do	do	Mar. 31, 1939		7.5	11.2	92.8	4.4	240				
Do	do	Apr. 4, 1939		9.5	10.6	92.6	3.7	460				
Do	do	Apr. 7, 1939		7.0	11.2	92.3	4.7	240				
Do	do	Apr. 10, 1939		10.5	11.2	99.9	2.2	150				
Do	do	Apr. 12, 1939		9.0	10.4	90.1	5.1	1,100				
Do	do	Apr. 17, 1939		11.5	10.5	95.7	3.8	150				
Do	do	Apr. 20, 1939		9.5	11.1	96.8	.5	460				
Do	do	Apr. 26, 1939		16.5	8.9	90.3	3.2	460				
Do	do	Apr. 28, 1939		17.0	8.7	88.9	3.0	930				
Do	do	May 1, 1939		14.5	9.6	93.6	2.6	230				
Do	do	May 4, 1939		15.0	9.1	89.5	4.0	2,400				
Do	do	May 8, 1939		19.5	9.1	97.9	4.3	36				
Do	do	May 12, 1939		17.0	7.3	75.4	4.5	430				
Do	do	May 16, 1939		17.0	8.7	89.0	5.0	73				
Do	do	May 19, 1939		21.5	7.6	85.0	5.2	43				
Do	do	May 22, 1939		24.5	6.4	76.3	4.7	43				
Do	do	May 24, 1939		23.5	5.4	62.4	4.8	43				
Do	do	June 2, 1939		26.0	4.9	59.7	5.0	460				
Do	do	June 5, 1939		23.5	6.5	76.0	4.3	93				
Do	do	June 7, 1939		27.0	6.4	79.8	5.1	23				
Do	do	June 13, 1939		19.0	7.2	76.5	4.1	1,100				
Do	do	June 16, 1939		24.5	6.0	70.7	2.7	150				
Miami River, Black St. Highway Bridge, Hamilton, Ohio.	Mi 35.9	Feb. 27, 1939		4.5	13.3	102.5	3.3	240				
Do	do	Mar. 3, 1939		4.0	12.8	97.6	3.6	460				
Do	do	Mar. 7, 1939		6.0	12.4	99.4	4.4	240				
Do	do	Mar. 10, 1939		9.0	10.8	93.2	Broken	460				
Do	do	Mar. 13, 1939		7.0	11.6	95.5	5.1	240				
Do	do	Mar. 15, 1939		8.5	11.0	93.8	5.9	240				
Do	do	Mar. 20, 1939		8.5	11.5	97.7	15.5	2,400				
Do	do	Mar. 23, 1939		11.5	10.1	92.2	24.7	930				
Do	do	June 19, 1939		23.0	5.1	58.8	7.2	2,400				
Do	do	June 28, 1939		25.5	6.0	72.0	4.2	930				
Do	do	July 5, 1939		23.5	6.4	75.0	4.0	2,400				
Do	do	July 21, 1939		23.0	6.6	76.0	3.0	230	7.6			
Do	do	Aug. 4, 1939		23.5	5.9	68.6	2.3	430				
Do	do	Aug. 18, 1939		27.0	5.4	66.3	4.3	73	7.7			
Do	do	Sept. 1, 1939		24.0	6.4	75.4	3.6	150	7.7			
Do	do	Sept. 15, 1939		26.5	4.8	58.7	3.7	46	7.6			
Do	do	Sept. 29, 1939		22.0	8.0	90.9	6.4	240	7.9			
Do	do	Oct. 13, 1939		17.5	5.3	55.3	5.1	93	7.6			
Do	do	Oct. 27, 1939		19.0	3.9	41.9	5.0	230	7.6			
Do	do	Nov. 10, 1939	680	10.0	6.9	60.8	4.6	460	7.5			
Do	do	Dec. 7, 1939	739	7.0	8.0	66.1	3.5	1,500				
Do	do	Dec. 21, 1939	616	5.0	8.4	65.6	4.2	430	7.6		260	
Do	do	Jan. 8, 1940	435	1.0	7.0	49.3	3.6	39	6.9			
Do	do	Jan. 23, 1940	1,030	0	12.3	84.4	4.9	150				
Do	do	Feb. 2, 1940	710	1.0	10.3	72.4	13.9	1,100	7.9			

[3] Less than 1.

TABLE MI–7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Miami River Bridge near Venice, below Hamilton, Ohio.	Mi 30.4	July 21, 1939		24.5	7.0	82.2	3.0	430	7.6			
Do	do	Aug. 4, 1939		23.5	5.8	67.8	3.0	1,500				
Do	do	Aug. 18, 1939		27.5	6.4	79.8	6.8	430	7.6			
Do	do	Sept. 1, 1939		24.0	6.5	76.7	6.1	2,300	7.9			
Do	do	Sept. 15, 1939		25.0	1.9	22.7	4.1	11,000	7.8			
Do	do	Sept. 29, 1939		21.5	3.5	38.9	11.7	2,400	7.5			
Do	do	Oct. 13, 1939		16.0	3.2	31.9	7.8	4,600	7.5			
Do	do	Oct. 27, 1939		19.5	5.0	54.4	1.5	720	7.5			
Do	do	Nov. 10, 1939	670	9.0	6.8	59.1	9.7	930	7.5			
Do	do	Dec. 7, 1939	739	6.0	7.6	60.5	6.7	390				
Do	do	Dec. 21, 1939	616	5.0	7.0	54.5	11.8	230	7.5			
Do	do	Jan. 8, 1940	990	0	10.2	69.6	10.9	930	7.5			
Do	do	Jan. 17, 1940	4,250	0	13.4	91.6	11.1	430	7.5			
Do	do	Jan. 23, 1940	756	0	12.1	83.0	9.4	430				
Do	do	Feb. 12, 1940	7,890	1.5	13.3	95.0	7.0	2,400	7.5			
Do	do	Feb. 19, 1940	9,050	3.5	13.0	97.9	7.5	93	7.8			
Do	do	Feb. 26, 1940	1,980	3.5	12.5	94.1	7.8	240	7.7			
Do	do	Mar. 1, 1940	3,090	7.5	12.1	100.5	6.2	460				
Do	do	Mar. 7, 1940	7,250	4.0	12.6	95.6	5.2	2,400	7.6			
Do	do	Mar. 13, 1940	2,680	6.5	11.0	89.4	7.7	1,100	7.7			
Do	do	Mar. 20, 1940	2,180	10.0	9.4	83.0	7.3	930	8.0			
Do	do	Mar. 28, 1940	1,450	7.0	10.0	82.3	9.2	2,400	7.8			
Do	do	Apr. 5, 1940	2,040	14.5	8.1	79.0	5.4	73	7.8			
Miami River, near Venice, below Hamilton, Ohio.	Mi 24.8	Feb. 21, 1939		5.5	11.4	89.9	5.5	1,100				
Do	do	Feb. 27, 1939		3.5	12.6	94.9	3.2	240				
Do	do	Mar. 3, 1939		4.5	12.8	98.4	4.0	240				
Do	do	Mar. 7, 1939		6.5	11.9	96.5	4.0	1,100				
Do	do	Mar. 10, 1939		8.5	10.8	92.5	4.2	460				
Do	do	Mar. 13, 1939		7.5	11.8	98.0	4.6	240				
Do	do	Mar. 15, 1939		8.5	11.1	95.0	3.6	460	8.0	520	124	
Do	do	Mar. 20, 1939		7.0	11.9	97.9	3.1	240	8.0	130	221	
Do	do	Mar. 23, 1939		10.5	10.1	90.5	4.8	460	8.1	58	238	
Do	do	Mar. 27, 1939		11.0	9.4	84.7	3.6	460	8.0	40	248	
Do	do	Mar. 31, 1939			11.2		4.3	430	8.1	140	208	
Do	do	Apr. 4, 1939		9.5	10.3	89.9	3.2	230				
Do	do	Apr. 7, 1939		7.0	11.4	93.3	4.1	460	8.1	190	194	
Do	do	Apr. 10, 1939		10.5	11.0	98.2	2.2	93				

Do	do	Apr. 12, 1939		9.0	10.6	91.1	4.7	210	8.0	70	226	
Do	do	Apr. 17, 1939		10.5	10.5	93.4	4.0	460	7.5	650	107	
Do	do	Apr. 20, 1939		9.5	11.0	96.2	3.0	460	7.2	180	162	
Do	do	Apr. 26, 1939		16.5	8.7	88.4	3.2	930				
Do	do	Apr. 28, 1939		17.0	8.4	86.1	3.6	150	7.5	40	238	
Do	do	May 1, 1939		14.0	9.5	91.6	2.6	91	8.0	38	256	
Do	do	May 4, 1939		15.0	9.1	89.7	3.5	430				
Do	do	May 8, 1939		19.5	9.8	106.0	4.5	36				
Do	do	May 12, 1939		17.5	9.3	96.8	4.4	430	8.1	10	244	
Do	do	May 16, 1939		17.0	9.3	95.2	6.3	230				
Do	do	May 19, 1939		21.0	9.6	106.8	5.4	91	8.1	15	249	
Do	do	May 22, 1939		22.0	7.9	89.5	4.9	240				
Do	do	May 24, 1939		23.0	8.7	100.1	5.8	150		20	250	
Do	do	June 2, 1939		25.0	7.6	91.1	5.2	460	8.0	22	240	
Do	do	June 5, 1939		23.0	7.9	90.8	5.1	230				
Do	do	June 7, 1939		26.5	8.2	100.7	5.1	150	8.3	40	244	
Do	do	June 13, 1939		19.0	6.8	72.6	5.3	460				
Do	do	June 16, 1939		24.5	6.1	71.7	3.3	240	7.9	38	218	
Do	do	June 19, 1939		23.5	4.7	54.4	5.9	2,400				
Do	do	June 28, 1939		26.0	6.6	80.4	4.2	930				
Do	do	July 5, 1939		23.5	6.7	78.1	3.8	1,500				
West Fork Whitewater River, above Hagerstown, Ind.	MiW 80	July 12, 1939		21.0	11.4	126.8	2.0	23				
Do	do	Aug. 8, 1939		18.5	8.8	92.7	.7	46				
Do	do	Oct. 10, 1939		17.0	8.2	84.6	.7	5	7.9			
Do	do	Nov. 7, 1939		7.5	10.6	88.2	.6	8	7.8			
Do	do	Dec. 18, 1939		6.0	11.7	93.8	.6	43	7.8			
Nettle Creek, above Hagerstown, Ind.	MiWN 80	July 12, 1939		22.5	11.1	126.9	1.1	7				
Do	do	Aug. 8, 1939		21.0	9.0	99.6	.7	9				
Do	do	Oct. 10, 1939		19.0	9.0	96.6	1.1	24	8.0			
Do	do	Nov. 7, 1939		7.0	11.0	90.6	.6	43	7.8			
Do	do	Dec. 18, 1939		6.0	11.5	92.0	.6	4	7.9			
West Fork Whitewater River, below Hagerstown, Ind.	MiWw 79	July 12, 1939		20.5	8.8	96.4	.8	29				
Do	do	Aug. 8, 1939		21.0	7.8	86.8	.7	24				
Do	do	Oct. 10, 1939		18.5	7.2	76.0	.4	110	7.9			
Do	do	Nov. 7, 1939		9.0	8.9	77.0	1.5	43	7.6			
Do	do	Dec. 18, 1939		7.5	11.2	93.4	.6	23	7.8			
West Fork Whitewater River, above Cambridge City, Ind.	MiWw 73	July 12, 1939	81	22.0	10.3	117.1	.9	93				
Do	do	Aug. 8, 1939	72	22.5	10.1	115.2	.8	15				
Do	do	Oct. 10, 1939	34	20.0	9.7	105.6	1.1	110	8.0			
Do	do	Nov. 7, 1939	45	6.5	11.5	93.2	.9	75	7.9			
Do	do	Dec. 18, 1939		5.5	12.0	94.9	.5	43	8.0			
West Fork, Whitewater River, below Cambridge City.	MiWw 72	July 12, 1939	81	22.5	11.5	131.5	.9	93				
Do	do	Aug. 8, 1939	72	22.0	9.0	101.6	.9	46				
Do	do	Oct. 10, 1939	34	20.0	8.3	90.5	1.4	46	8.0			
Do	do	Nov. 7, 1939	45	7.0	11.1	91.0	.5	43	8.0			
Do	do	Dec. 18, 1939		6.0	11.5	92.4	.4	43	8.0			

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
West Fork, Whitewater River, above Connersville, Ind.	MiWw 62	July 13, 1939		23.5	8.4	98.3	.8	8				
Do	do	July 25, 1939		22.5	9.6	109.9	.6	21				
Do	do	Aug. 9, 1939		21.5	8.4	94.8	1.7	43				
Do	do	Aug. 22, 1939		18.0	8.6	90.0	1.5	43	8.0			
Do	do	Sept. 19, 1939	69	16.5	8.2	83.8	1.2	5	7.9			
Do	do	Oct. 17, 1939	64	10.5	9.6	85.4	.7	11	7.9			
Do	do	Nov. 14, 1939	85	6.0	10.7	85.7	.4	1	7.8			
Do	do	Dec. 26, 1939		2.0	11.6	83.5	1.3	4	7.6	5		
Do	do	Jan. 19, 1940		0	12.4	84.8	1.0	24	7.7			
Do	do	Jan. 30, 1940		0	12.5	85.2	.4	24				
Do	do	Feb. 7, 1940		0	12.0	82.4	6.2	43	7.8			
Do	do	Feb. 15, 1940		2.0	13.4	97.0	1.6	93	7.7			
Do	do	Feb. 21, 1940		3.0	11.9	88.6	2.8	160	7.7			
Do	do	Feb. 28, 1940		4.0	12.1	92.5	3.7	24	7.5			
Do	do	Mar. 5, 1940		4.0	12.0	91.8	1.4	46	7.7			
Do	do	Mar. 11, 1940		4.5	11.9	91.8	.5	4	8.0			
Do	do	Mar. 15, 1940		2.5	12.1	88.6	.5	9	8.1			
Do	do	Mar. 22, 1940		4.0	12.4	94.1	.6	2				
Do	do	Apr. 1, 1940		12.0	11.4	105.3	1.3	(¹)	7.9			
West Fork, Whitewater River, below Connersville, Ind.	MiWw 61	July 13, 1939		24.0	7.9	92.5	2.5	460				
Do	do	July 25, 1939		23.5	7.8	91.0	2.8	240				
Do	do	Aug. 9, 1939		24.0	7.0	81.5	1.6	430				
Do	do	Aug. 22, 1939		19.5	7.5	80.8	1.4	230	8.0			
Do	do	Sept. 19, 1939	69	19.0	7.2	77.3	2.0	460	8.0			
Do	do	Oct. 17, 1939	64	11.0	8.5	76.5	1.4	430	7.9			
Do	do	Nov. 14, 1939	85	6.0	11.0	88.1	1.0	240	7.8			
Do	do	Dec. 26, 1939		2.0	14.0	101.2	3.0	930	7.8	7		
Do	do	Jan. 19, 1940		0	13.3	90.8	1.9	240	7.8			
Do	do	Jan. 30, 1940		0	13.2	90.1	1.1	240				
Do	do	Feb. 7, 1940		0	12.1	83.0	6.4	460	7.8			
Do	do	Feb. 15, 1940		2.0	13.3	96.0	3.3	240	7.8			
Do	do	Feb. 21, 1940		2.5	11.8	86.7	3.8	93	7.8			
Do	do	Feb. 28, 1940		3.5	12.3	92.3	3.5	110	7.8			
Do	do	Mar. 5, 1940		4.5	10.7	82.5	2.0	460	7.6			
Do	do	Mar. 11, 1940		5.5	11.7	92.8	1.1	46	8.0			
Do	do	Mar. 15, 1940		3.5	11.8	88.9	1.4	110	7.9			
Do	do	Mar. 22, 1940		4.0	12.3	93.5	1.1	110				
Do	do	Apr. 1, 1940		13.0	10.6	100.3	3.1	460	8.0			

West Fork, Whitewater River, above Brookville, Ind.	MiWw 33	July 13, 1939		24.5	9.3	110.1	.9	9				
Do	do	July 25, 1939		22.5	8.4	96.6	1.0	9				
Do	do	Aug. 9, 1939		23.0	7.8	89.3	1.1	9				
Do	do	Aug. 22, 1939		20.0	7.8	85.0	1.2	43	8.1			
Do	do	Sept. 19, 1939		17.5	8.2	85.6	.9	4	8.1			
Do	do	Oct. 17, 1939		10.0	9.9	87.7	.6	4	7.9			
Do	do	Nov. 14, 1939		5.0	11.8	92.0	.4	4	8.0			
Do	do	Dec. 26, 1939		3.5	13.6	102.1	2.0	2	7.9	8		
Do	do	Jan. 19, 1940		0	Lost		1.7	240	7.8			
Do	do	Jan. 30, 1940		0	12.7	86.7	1.1	4				
Do	do	Feb. 7, 1940		0	13.3	90.7	8.6	460	7.5			
Do	do	Feb. 15, 1940		1.0	12.7	89.4	2.3	460	7.8			
Do	do	Feb. 21, 1940		5.0	12.7	99.1	3.4	150	7.7			
Do	do	Feb. 28, 1940		4.0	12.6	95.8	2.8	460	7.9			
Do	do	Mar. 5, 1940		7.0	12.0	98.9	1.8	240	7.8			
Do	do	Mar. 11, 1940		7.0	11.7	96.3	.6	4	8.0			
Do	do	Mar. 15, 1940		6.0	12.3	98.9	.8	9	8.0			
Do	do	Mar. 25, 1940		4.5	12.7	97.8	.9	24	8.1			
Do	do	Apr. 2, 1940		12.0	10.6	98.1	1.3	4	7.8			
East Fork, Whitewater River, above Richmond, Ind.	MiWe 66	July 12, 1939	89	23.5	7.8	90.5	1.3	93				
Do	do	Aug. 8, 1939	79	24.0	6.4	74.4	1.7	240				
Do	do	Oct. 10, 1939	37	23.0	5.0	57.1	1.6	240	7.9			
Do	do	Nov. 7, 1939	49	10.0	8.2	72.2	1.5	230	7.9			
Do	do	Dec. 18, 1939		7.0	9.9	81.3	1.1	750	8.0			
Do	do	Feb. 21, 1940		3.5	12.8	96.5	2.1	93	7.9			
Do	do	Feb. 28, 1940		4.0	12.4	94.7	4.3	240	7.8			
Do	do	Mar. 5, 1940		4.5	12.4	96.0	1.9	24	7.8			
Do	do	Mar. 11, 1940		2.5	12.6	92.2	.9	24	8.0			
Do	do	Mar. 15, 1940		2.0	12.8	92.5	1.5	46	8.0			
Do	do	Mar. 22, 1940		5.0	13.5	105.2	1.1	240				
Do	do	Apr. 1, 1940		12.0	10.8	99.4	1.6	24	8.2			
East Fork, Whitewater River, below Richmond, Ind	MiWe 65	July 12, 1939	89	22.0	8.0	90.3	2.8	150				
Do	do	Aug. 8, 1939	79	23.0	6.4	73.4	2.5	240				
Do	do	Oct. 10, 1939	37	22.0	5.6	54.0	2.1	240	7.9			
Do	do	Nov. 7, 1939	49	10.0	10.0	88.4	2.4	230	7.9			
Do	do	Dec. 18, 1939		6.5	10.5	85.2	1.4	430	7.8			
Do	do	Jan. 19, 1940		0	13.8	94.5	3.1	93	7.8			
Do	do	Jan. 30, 1940		5.0	11.8	92.2	2.8	240				
Do	do	Feb. 7, 1940		2.0	11.6	84.0	8.0	290	7.8			
Do	do	Feb. 15, 1940		3.0	13.5	100.4	2.5	43	7.8			
Do	do	Feb. 21, 1940		5.0	12.5	97.8	5.6	1,100	8.0			
Do	do	Feb. 28, 1940		4.5	12.4	95.8	4.5	93	7.8			
Do	do	Mar. 5, 1940		4.0	12.4	94.3	2.5	24	7.7			
Do	do	Mar. 11, 1940		2.5	12.5	91.7	2.0	9	8.0			
Do	do	Mar. 15, 1940		3.5	12.6	94.9	4.4	46	7.9			
Do	do	Mar. 22, 1940		6.0	15.5	124.0	2.0	46				
Do	do	Apr. 1, 1940		12.5	12.6	117.3	3.7	110	8.2			

[1] Less than 1.

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
East Fork Whitewater River, above Brookville, Ind.	MiWe 33	July 13, 1939		23.5	9.1	105.6	1.0	24				
Do	do	July 25, 1939		22.5	9.3	106.3	1.3	9				
Do	do	Aug. 9, 1939		22.5	8.2	94.1	1.1	75				
Do	do	Aug. 22, 1939		20.0	8.1	87.9	1.4	93	8.1			
Do	do	Sept. 19, 1939		18.5	8.0	85.1	1.1	24	8.1			
Do	do	Oct. 17, 1939		10.0	10.4	91.8	1.3	2	7.9			
Do	do	Nov. 14, 1939		4.0	12.6	96.3	.8	9	8.2			
Do	do	Dec. 26, 1939		1.5	14.7	104.8	2.4	(2)	8.2	5		
Do	do	Jan. 19, 1940		0	Lost		2.1	24	7.7			
Do	do	Jan. 30, 1940		0	12.7	86.9	1.7	8				
Do	do	Feb. 7, 1940		.5	13.2	91.6	8.3	150	7.5			
Do	do	Feb. 15, 1940		1.0	12.8	90.0	1.8	93	7.9			
Do	do	Feb. 21, 1940		4.0	12.8	97.8	2.0	93	7.8			
Do	do	Feb. 28, 1940		4.5	12.6	97.0	2.9	240	7.9			
Do	do	Mar. 5, 1940		5.5	12.2	96.4	1.7	240	7.8			
Do	do	Mar. 11, 1940		7.0	12.2	100.2	.7	9	8.0			
Do	do	Mar. 15, 1940		7.0	12.7	104.6	.7	24	8.0			
Do	do	Mar. 25, 1940		4.0	12.8	97.7	1.2	(2)	8.1			
Do	do	Apr. 2, 1940		12.0	11.3	104.4	2.0	1	8.0			
Whitewater River, below Brookville, Ind.	MiW 31	July 13, 1939	505	23.5	7.8	91.3	1.1	93				
Do	do	July 25, 1939	433	23.0	8.1	93.3	.9	46				
Do	do	Aug. 9, 1939	333	23.5	7.5	87.1	1.1	93				
Do	do	Aug. 22, 1939	461	20.5	7.6	83.7	1.2	460	8.1			
Do	do	Sept. 19, 1939	140	18.0	8.2	85.7	.9	240	8.1			
Do	do	Oct. 17, 1939	133	10.5	9.7	86.4	.5	23	7.9			
Do	do	Nov. 14, 1939	160	5.5	11.7	92.8	.6	24	7.9	15		
Do	do	Dec. 26, 1939	156	2.0	13.3	96.1	2.0	93	8.0	7		
Do	do	Jan. 19, 1940	297	0	Lost		3.8	93	7.8			
Do	do	Jan. 30, 1940	220	1.0	12.6	88.3	1.1	4				
Do	do	Feb. 7, 1940	1,230	1.0	13.1	92.1	8.3	93	7.5			
Do	do	Feb. 15, 1940	830	1.5	13.0	92.9	2.0	93	7.7			
Do	do	Feb. 21, 1940	1,380	5.0	12.6	98.8	3.0	460	7.7			
Do	do	Feb. 28, 1940	1,460	7.0	12.5	102.5	2.5	1,100	7.9			
Do	do	Mar. 5, 1940	2,290	8.0	12.0	101.3	1.6	110	7.7			
Do	do	Mar. 11, 1930	749	10.0	11.7	103.5	.6	24	8.0			
Do	do	Mar. 15, 1940	649	4.5	12.5	96.1	1.2	21	8.0			
Do	do	Mar. 25, 1940	385	5.5	12.6	99.9	.8	9	8.1			
Do	do	Apr. 2, 1940	359	13.0	10.2	95.9	1.5	24	8.0			

Whitewater River, above Harrison, Ind.	*MiW 14*	*July 13, 1939*		24.0	7.8	91.1	.9	15				
Do	do	July 25, 1939		22.5	8.2	93.4	1.3	9				
Do	do	Aug. 9, 1939		23.5	7.8	91.3	1.4	7				
Do	do	Aug. 22, 1939		21.5	7.4	82.5	1.6	93	8.0			
Do	do	Sept. 19, 1939		19.5	7.6	81.9	1.1	11	8.0			
Do	do	Oct. 17, 1939		11.5	9.6	88.0	.4	5	7.9			
Do	do	Nov. 14, 1939		5.0	12.4	97.1	.5	4	8.1	8		
Do	do	Dec. 26, 1939		3.0	14.1	104.6	1.4	1	8.1	3		
Whitewater River, below Harrison, Ind.	MiW 13	Feb. 21, 1939	2,910	6.5	11.6	94.4	2.8	23				
Do	do	Feb. 27, 1939	1,470	4.5	12.9	99.5	1.8	93				
Do	do	Mar. 3, 1939		5.5	12.2	96.7	1.1	23				
Do	do	Mar. 7, 1939		7.0	12.0	98.9	1.6	39				
Do	do	Mar. 10, 1939		8.0	11.3	95.5	.6	23				
Do	do	Mar. 13, 1939		7.5	11.2	93.0	3.5	93				
Do	do	Mar. 15, 1939		10.0	10.4	91.4	1.2	39				
Do	do	Mar. 20, 1939		8.5	11.7	100.1	.8	9				
Do	do	Mar. 23, 1939		11.0	11.0	99.4	.9	4				
Do	do	Mar. 27, 1939		11.0	9.2	83.1	1.3	8				
Do	do	Mar. 31, 1939			11.6		1.1	240				
Do	do	Apr. 4, 1939		10.0	11.2	99.3	.6	4				
Do	do	Apr. 7, 1939		7.0	11.5	94.8	1.9	24				
Do	do	Apr. 10, 1939		11.5	11.1	101.0	.6	9				
Do	do	Apr. 12, 1939		8.0	11.2	94.4	.8					
Do	do	Apr. 17, 1939		12.0	10.2	94.2	2.5	43				
Do	do	Apr. 20, 1939		9.5	10.8	94.2	1.2	93				
Do	do	Apr. 26, 1939		16.5	9.2	93.5	.7	23				
Do	do	Apr. 28, 1939		16.0	8.9	89.6	1.4	43				
Do	do	May 1, 1939		14.5	9.8	95.2	.9	230				
Do	do	May 4, 1939		14.5	10.1	98.3	.8	23				
Do	do	May 8, 1939		19.0	9.4	100.7	1.2	4				
Do	do	May 12, 1939		17.0	9.5	97.7	1.1	2				
Do	do	May 16, 1939		16.5	9.3	94.4	1.0	9				
Do	do	May 19, 1939		20.0	9.0	97.8	1.3	4				
Do	do	May 22, 1939		21.5	8.7	98.0	1.7	7				
Do	do	May 24, 1939		22.5	8.3	95.2	1.6	24				
Do	do	June 2, 1939		24.5	9.1	107.9	2.0	4				
Do	do	June 5, 1939		22.0	8.5	96.3	1.9	46				
Do	do	June 7, 1939		25.5	8.6	103.9	1.6	24				
Do	do	June 13, 1939		19.0	8.2	87.6	3.0	240				
Do	do	June 16, 1939		25.0	7.7	92.4	1.6	150				
Do	do	June 19, 1939		23.0	7.3	84.4	4.5	1,100				
Do	do	June 28, 1939		26.5	6.4	78.3	4.1	110				
Do	do	July 5, 1939		24.5	7.2	85.6	3.2	2,400				
Do	do	July 13, 1939		23.5	8.0	93.0	1.3	9				
Do	do	July 25, 1939		23.0	8.2	94.8	1.8	24				
Do	do	Aug. 9, 1939		24.0	8.1	94.6	1.7	9				
Do	do	Aug. 22, 1939		22.0	7.4	83.2	1.8	240	8.0			

[3] Less than 1.

TABLE MI-7.—*Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Whitewater River, below Harrison, Ind.	MiW 13	Sept. 19, 1939	190	19.5	7.7	83.4	1.4	9	8.0	------	------	------
Do	do	Oct. 17, 1939	170	12.0	9.6	89.0	.6	1	7.9		------	------
Do	do	Nov. 14, 1939	210	6.0	12.3	98.3	.4	4	8.0	7	------	------
Do	do	Dec. 26, 1939	------	2.0	14.1	101.9	1.8	2	------	5	------	------
Do	do	Jan. 19, 1940	------	0	Lost	------	1.9	93	7.8	------	------	------
Do	do	Feb. 21, 1940	------	4.5	12.7	98.2	2.8	240	7.8	------	------	------
Do	do	Feb. 28, 1940	------	7.0	12.2	100.2	.9	46	7.8	------	------	------
Do	do	Mar. 5, 1940	------	8.5	12.0	102.3	1.6	240	7.8	------	------	------
Do	do	Mar. 11, 1940	------	7.0	11.7	96.3	.7	15	8.0	------	------	------
Do	do	Mar. 15, 1940	------	7.0	12.3	101.2	.9	24	8.0	------	------	------
Do	do	Mar. 25, 1940	------	4.0	11.8	89.6	1.0	1	8.2	------	------	------
Do	do	Apr. 2, 1940	------	14.0	10.1	97.4	1.1	2	7.9	------	------	------
Miami River, Cleves Bridge	Mi 4.2	Mar. 3, 1939	16,860	4.0	12.3	93.7	1.9	240	------	------	------	------
Do	do	Mar. 7, 1939	11,710	4.5	12.0	92.5	7.0	120	------	------	------	------
Do	do	Mar. 13, 1939	35,100	7.0	11.1	91.4	3.9	460	------	------	------	------
Do	do	Mar. 21, 1939	5,600	8.0	11.2	94.2	4.7	240	8.2	85	244	------
Do	do	Apr. 4, 1939	------	10.5	10.9	97.1	1.4	43	8.2	25	244	------
Do	do	Apr. 10, 1939	6,400	9.0	9.9	85.1	3.2	23	8.1	28	236	------
Do	do	Apr. 26, 1939	8,450	17.0	8.4	86.6	4.0	460	7.8	67	236	------
Do	do	May 4, 1939	4,480	15.0	9.8	96.2	1.9	9	8.0	18	252	------
Do	do	May 8, 1939	3,690	20.0	9.9	108.3	7.1	11	8.0	20	251	------
Do	do	May 16, 1939	3,040	19.0	9.5	101.9	4.8	460	8.3	10	238	------
Do	do	May 22, 1939	3,060	23.0	8.2	94.2	4.0	43	8.0	40	238	------
Do	do	June 5, 1939	2,150	23.5	8.5	98.6	8.7	150	8.0	70	243	------
Do	do	June 13, 1939	------	25.0	7.6	90.7	3.6	240	8.3	150	216	------
Do	do	June 19, 1939	21,700	25.0	6.8	80.9	4.8	1,100	7.9	470	126	------
Do	do	June 27, 1939	3,750	25.5	7.2	86.3	2.3	93	8.0	100	225	------
Do	do	June 28, 1939	------	25.5	7.4	89.8	1.2	43	7.6	64	255	------
Do	do	July 5, 1939	7,030	27.0	6.4	79.3	4.0	2,400	8.0	3,100	------	------
Do	do	July 11, 1939	3,210	25.0	6.7	79.6	3.7	930	7.7	310	193	------
Do	do	July 17, 1939	1,730	24.0	10.0	117.2	4.6	230	7.9	57	228	------
Do	do	July 19, 1939	7,300	23.5	6.7	78.3	4.4	1,500	7.7	525	163	------
Do	do	July 25, 1939	1,660	25.5	8.5	102.8	3.5	430	8.0	53	239	------
Do	do	July 31, 1939	14,990	23.5	5.4	62.8	4.4	4,600	7.6	800	151	------
Do	do	Aug. 2, 1939	5,200	25.0	6.8	80.7	2.8	230	7.8	200	154	------
Do	do	Aug. 8, 1939	2,120	25.0	7.8	93.4	3.2	230	8.0	70	230	------
Do	do	Aug. 14, 1939	2,350	26.0	7.1	85.9	5.4	930	8.3	240	199	------
Do	do	Aug. 16, 1939	1,700	27.0	7.5	93.4	4.0	230	8.1	60	212	------

Do	do	Aug. 22, 1939	2,300	24.0	7.4	86.2	3.7	930	8.1	87	216	
Do	do	Aug. 28, 1939	1,340	23.0	9.6	110.4	3.8	36	8.0	25	226	
Do	do	Aug. 30, 1939	1,300	23.5	10.2	119.2	5.0	46	8.1	31	222	
Do	do	Sept. 5, 1939	1,020	23.0	8.1	93.2	5.3	93	8.1	27	225	
Do	do	Sept. 11, 1939	920	21.5	8.4	94.3	3.6	23	8.1	38	222	
Do	do	Sept. 13, 1939	950	23.5	8.0	93.0	3.3	43	7.9	18	213	
Do	do	Sept. 19, 1939	880	21.5	8.0	89.8	2.4	43	7.9	42	236	
Do	do	Sept. 25, 1939	810	21.0	8.5	94.3	3.4	21	7.9	25	232	
Do	do	Sept. 27, 1939	830	20.0	8.8	95.7	5.9	24	7.9	18	234	
Do	do	Oct. 3, 1939	830	15.0	9.4	92.4	3.7	75	7.9	10	228	
Do	do	Oct. 9, 1939	830	22.5	7.8	89.0	4.8	46	7.9	20	232	
Do	do	Oct. 11, 1939	700	19.5	7.5	80.8	4.5	23	7.9	13	227	
Do	do	Oct. 17, 1939	710	12.5	9.2	85.5	2.6	46	7.9	8	245	
Do	do	Oct. 23, 1939	720	13.5	9.9	94.5	5.2	43	8.0	12	248	
Do	do	Oct. 25, 1939	830	16.0	8.2	82.1	5.6	24	7.8	15	250	
Do	do	Oct. 31, 1939	1,400	10.5	8.0	71.7	4.9	91	7.7	32	219	
Do	do	Nov. 6, 1939	930	7.0	9.2	76.0	3.4	240	7.7	25	229	
Do	do	Nov. 8, 1939	960	7.5	9.4	78.5	3.4	460	7.7	15	243	
Do	do	Nov. 14, 1939	860	7.0	9.9	81.6	2.7	150	7.7		253	
Do	do	Nov. 20, 1939	860	8.0	9.0	76.1	2.9	23	7.7	25	243	
Do	do	Nov. 22, 1939	1,040	7.0	9.8	80.9	3.5	24	7.8	17	242	
Do	do	Nov. 28, 1939	920	5.0	9.9	77.3	3.5	240	7.8	9	264	
Do	do	Dec. 4, 1939	1,130	6.0	9.6	76.8	3.4	93		15	248	
Do	do	Dec. 6, 1939	1,100	6.0	9.6	76.8	3.3	93		18	250	
Do	do	Dec. 12, 1939	900	7.0	9.3	76.2	3.0	93	7.9	11	245	
Do	do	Dec. 18, 1939	890	8.0	9.7	81.7	3.6	15	7.8	5	249	
Do	do	Dec. 20, 1939	890	5.5	9.2	72.7	2.6	93	7.6	7	250	
Do	do	Dec. 26, 1939	800	2.5	11.1	81.3	3.3	150	7.4	15	257	
Do	do	Jan. 3, 1940	617	0	12.1	82.9	1.6	43	7.8	9	269	
Do	do	Jan. 17, 1940	4,630	1.0	13.3	93.7	6.6	460	7.6	380	161	
Do	do	Feb. 2, 1940	1,040	1.0	9.4	66.2	4.9	43	8.0			
Do	do	Feb. 12, 1940	11,950	3.0	12.3	91.4	7.4	230	7.6			
Do	do	Feb. 19, 1940	18,240	5.0	12.8	100.0	6.9	240	7.8	850	104	
Do	do	Feb. 26, 1940	2,820	2.0	12.5	90.3	3.0	460	7.7	48	195	
Do	do	Feb. 28, 1940	4,410	3.0	11.8	87.5	5.2	240	7.8	57	214	
Do	do	Mar. 5, 1940	22,400	5.0	11.4	89.3	4.0	39	7.6	700	105	
Do	do	Mar. 11, 1940	4,350	5.0	11.4	88.8	3.1	1,100	8.0	67	210	
Do	do	Mar. 13, 1940	3,730	5.0	11.3	88.5	4.2	11,000	7.9	40	216	
Do	do	Mar. 19, 1940	3,080	8.0	10.1	84.9	5.0	430	7.9	55	225	
Do	do	Mar. 25, 1940	2,140	4.0	9.1	69.5	2.6	930	8.0	25		
Do	do	Mar. 27, 1940	2,030	6.0	11.0	87.7	4.4	240	7.8	33	236	
Do	do	Apr. 2, 1940	2,210	8.5	9.0	76.7	3.2	23	7.8	25	230	
Do	do	Apr. 8, 1940	4,210	12.0	9.5	87.9	4.2	150	7.9	30	225	
Do	do	Apr. 10, 1940	5,850	9.5	9.1	79.6	5.4	1,100	7.9	65		
Do	do	Apr. 30, 1940	5,240	14.0			6.3	460	7.9	140	222	

LITTLE MIAMI RIVER BASIN

CONTENTS

	Page
Contents	645
Syllabus and conclusions	647
Description	648
Presentation of field data	649
Presentation of laboratory data	651
Hydrometric data	653
Discussion	654

LIST OF TABLES

Lm–1.—Cost estimates of remedial measures	648
Lm–2.—Surface water supplies	650
Lm–3.—Sources of pollution	650
Lm–4.—Industrial wastes	651
Lm–5.—Selected laboratory data	651
Lm–6.—Hydrometric data	653
Lm–7.—Summary of laboratory results	655

LIST OF FIGURES

Lm–2.—Chart—Sources of pollution and selected laboratory data	650

(NOTE.—For maps of this basin see Miami River Basin.)

LITTLE MIAMI RIVER BASIN [1]

Syllabus and Conclusions

SYLLABUS

The Little Miami Drainage Basin, occupying 1,755 square miles wholly within the State of Ohio, is principally an agricultural region with only minor industrial development. Exclusive of the Cincinnati metropolitan area, the population of the basin totals about 135,000, of which 35 percent reside in 41 incorporated communities. Primary water uses of major streams are recreational and agricultural. Recreational development is notable in the lower reaches. In terms of expenditures, existing waste treatment facilities represent about 50 percent of total suggested treatment. Remaining water pollution problems are not critical, are of local significance, and can be solved by practical methods of waste treatment.

CONCLUSIONS

(1) Of 21 public water supplies in the basin only 4 use surface sources, 2 of which are on tributaries affected by sewage pollution. An increasing need for surface waters for water supply purposes is noted in the basin as well as demands for improved recreational areas, the latter especially in the lower reaches near Cincinnati.

(2) Outside the Cincinnati area, sewage from 31,700 people and industrial wastes with a population equivalent of 9,700 enter the streams. More than 75 percent of the sewage is treated.

(3) Laboratory observations show several bad areas below sources of pollution but indicate rather rapid stream recovery after short periods of flow. Coliform results averaging over 200 per milliliter during the worst month were found over most of the basin.

(4) Minimum monthly summer flows in the lower reach have varied from 70 to 85 cubic feet per second for several years within the period of record. Flows on East Fork often reach zero for extended periods.

(5) The Little Miami River below mile 5 receives pollution aggregating about 129,000 equivalent population from a portion of metropolitan Cincinnati. Interceptor sewers are under construction to divert this waste to a point of treatment with subsequent discharge direct to the Ohio River.

(6) Sections of several tributaries are polluted due to improper waste treatment. Practical treatment of sewage and industrial waste will control pollution and adequately protect surface streams for all normal uses except in certain sections of tributaries where near-zero summer flows occur in the vicinity of outfalls.

(7) Low-flow regulation by the proposed East Fork flood-control reservoir would eliminate the need for more than primary sewage treatment at Batavia, would ensure the adequacy of the community's

[1] For maps of this basin, see Miami River Basin.

public water supply, and would enhance the recreational value of the East Fork.

(8) In view of the normal uses of the streams involved, refined treatment at a few sources of pollution would serve no purpose commensurate with the expenditure. In these instances, lesser treatment appears justified and has been suggested. Summary of comparative cost of remedial measures from table Lm–1 follows:

Treatment	Capital cost	Annual charges
Existing	$530,000	$55,000
Suggested additional	580,000	60,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are—

Treatment	Capital cost	Annual charges
Primary, all places	$420,000	$45,000
Secondary, all places	620,000	65,000

TABLE LM–1.—*Little Miami River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	3	8	24,600	$530,000	$35,000	$20,000	$55,000
Suggested minimum correction:							
Sewage treatment plants	3	8	7,100	410,000	29,000	16,000	45,000
Required interceptors			6,700	120,000	5,000		5,000
Independent industrial waste correction				50,000	6,000	4,000	10,000
Total				580,000	40,000	20,000	60,000
Comparative cost:							
Primary treatment, all waste				420,000	30,000	15,000	45,000
Secondary treatment, all waste				620,000	45,000	20,000	65,000
As suggested				580,000	40,000	20,000	60,000

DESCRIPTION

The Little Miami River, draining 1,755 square miles in southwestern Ohio, rises in Clark County and flows southwesterly for about 100 miles to join the Ohio River near the eastern city limits of Cincinnati. The generally uniform stream bed, free from significant rapids, is 1,150 feet above mean sea level near headwaters and has a uniform gradient of about 6.5 feet per mile.

	River mile	Drainage area (square miles)
Major tributaries:		
East Fork	12	501
Todd Fork	39	261
Caesar Creek	51	239

	Populations			
	1910	1920	1930	1940
Larger cities:				
Xenia	8,706	9,110	10,507	10,633
Wilmington	4,491	5,037	5,332	5,971
Lebanon	2,698	3,396	3,222	3,890
Total basin:				
Rural	97,144	93,867	99,991	111,470
Urban	21,088	17,543	19,061	24,004
Total	118,232	111,410	119,052	135,474

Industries.—Municipalities in the basin are essentially trading and distributing centers. Agriculture is the chief basin occupation and corn and garden truck are principal crops. Cattle, sheep, and hogs are raised in large numbers. Waste byproducts from vegetable canneries is of special stream-pollution significance and operating seasons coincide with critical stream conditions.

Water uses.—Three communities on East Fork with a combined population of 1,700 and one on Todd Fork with a population of 1,500 use surface streams as a source of water supply. Stock watering from surface streams is common throughout the basin.

Recreation, including fishing, summer cottages, and boating, is observed in the basin with special concentration in the lower reach near metropolitan Cincinnati.

Navigation improvements are not considered on this stream. Flood-control reservoirs at five sites on the Little Miami River and its tributaries have been studied by the United States Engineer Department.

Presentation of Field Data

Figure Mi–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure Lm–2 shows similar data and, in addition, the location of water-supply intakes from streams below source of pollution and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Water supply.—In the basin, 21 public water-supply systems serve 39,100 people. Supplies shown in table Lm–2 are from surface streams. Greater future use of surface waters is indicated. Ground water is limited in many sections and is generally hard with high iron content.

TABLE LM-2.—*Little Miami River Basin: Surface water supplies*

Municipality	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls				
Batavia	East Fork	23	FD	1,100	0.07
Williamsburg	do	45	FD	400	.03
	Other surface supplies				
St. Martin	Impounded		FD	200	0.01
Blanchester	do		FD	1,500	.05
Total:					
Below sewer outfalls				1,500	.10
Other				1,700	.06
Total surface water supplies				3,200	.16

[1] Miles above mouth of Little Miami River.
[2] F=coagulated, settled, filtered; D=chlorinated.

Sewage.—Table Lm–3 shows the population served by sewers at each of the more important sources of pollution in the basin. Cincinnati and its suburbs are the largest contributors of wastes. Interceptor construction now in progress will remove these wastes from the Little Miami. After treatment they will be discharged to the Ohio River. Sewage from 31,700 people in other communities enters the streams of the basin and of these 24,600 are served by the 11 sewage treatment plants.

TABLE LM-3.—*Little Miami River Basin: Sources of significant pollution including industrial waste expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	River	Miles above mouth of Little Miami River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Cincinnati and suburbs	Little Miami	5	78,000	None	129,000	129,000
Milford	do	14	1,500	do	1,500	1,500
Waynesville [1]	do	54	500	Secondary	2,000	1,600
Roxanna	do	60			1,500	1,500
Yellow Springs	do	84	1,000	Secondary	1,000	100
New Vienna	East Fork	90	400	None	1,400	1,400
Lebanon [1]	Turtle Creek	40	3,100	Chemical precipitation.	5,300	2,600
Blanchester	Second Creek	50	1,200	None	2,000	2,000
Wilmington	Lytle Creek	63	5,000	Chemical precipitation.	6,110	1,800
Jamestown	Caesar Creek	82	900	Secondary	1,500	700
Xenia	Shawnee Creek	80	11,000	do	11,000	1,600
Orphans Home	do	82	1,000	do	1,000	100
Wilberforce	Massie Creek	82	1,000	do	1,000	100
11 smaller sources			5,100	Various	6,100	5,100
Total			109,700		170,400	149,100

[1] Recent treatment plant. Not in operation in 1939.

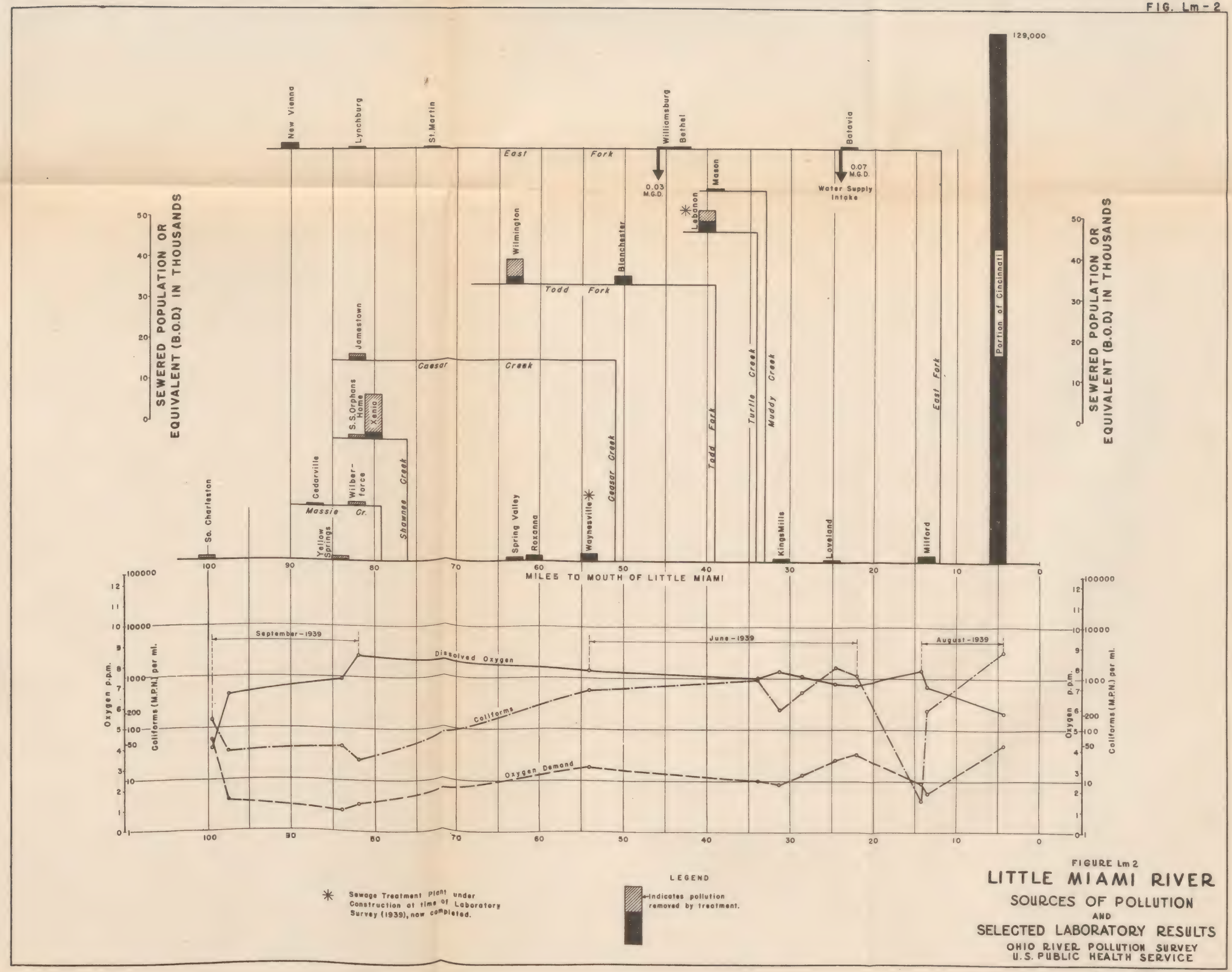


FIGURE Lm 2
LITTLE MIAMI RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY RESULTS
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE

Industrial wastes.—The only industries discharging wastes of consequence other than to municipal treatment plants and outside the Cincinnati area are eight vegetable canneries. In addition, two vegetable canneries discharge wastes to municipal treatment works. Four others have taken steps to reduce the strength of the wastes before they leave the plant. Table Lm–4 shows data on the industrial waste load in the basin.

TABLE LM–4.—*Little Miami River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Canneries	8	1	7	4	6,900
Waste unconnected, municipal treatment	8	1	7	4	6,900
Industrial waste to Cincinnati sewers [1]					51,000
Waste discharged to municipal treatment					2,800
Total industrial wastes in the basin					60,700

[1] Industries not surveyed individually. Population equivalent based on comprehensive sewer gaging and sampling program of city.

PRESENTATION OF LABORATORY DATA

The laboratory data for the Little Miami River Basin are summarized in table Lm–7 (p. 655). Selected results of the analytical observations are shown in table Lm–5 to depict typical low flow conditions at major points on the Little Miami River and major tributaries. Spot symbol maps showing the most unfavorable monthly average coliform, dissolved oxygen and biochemical oxygen demand results are presented in figures Mi–3, Mi–4, and Mi–5 (p. 610), respectively.

TABLE LM–5.—*Little Miami River; Selected laboratory data—Main stream and tributaries*

River	Little Miami	Little Miami	Little Miami	Little Miami	Little Miami	Little Miami	Little Miami
Location	Above Yellow Springs	Below Yellow Springs	Above Turtle Creek	Below Turtle Creek	Above Milford	Below Milford	Beechmont Bridge
River miles above mouth of Little Miami.	85.5	84	33.8	31.2	14.2	13.3	4.3
Period, 1939	July–September	July–September	August	August	August	August	September–October
Number of samples	3	3	3	3	1	1	4
Flow in cubic feet per second:							
Sampling days	64	64	1.0	1.0	105	105	125
Minimum month	----	----	----	----	57.5	57.5	72
Water temperature °C	19.8	18.5	22.8	23.5	23.5	23.5	17.6
Coliforms per milliliter	31	21	47	18	4	23	4,580
Dissolved oxygen, parts per million	7.6	8.2	7.8	8.3	7.9	9	2.8
Biochemical oxygen demand, 5-day, parts per million	0.9	1.2	1.3	1.5	2.7	2.9	6.5

TABLE LM-5.—*Little Miami River; Selected laboratory data—Main stream and tributaries*—Continued

River	Shawnee Creek	Todd Fork	Todd Fork	East Fork	East Fork	East Fork	East Fork
Location	Below Xenia	Above Wilmington	Below Wilmington	Above Lynchburg	Below Lynchburg	Above Batavia	Below Baatvia
River miles above:							
Confluence with Little Miami.	1	27.5	20.5	73	68	13	8
Mouth of Little Miami	76.1	66.5	59.5	85	80	25	20
Period, 1939	August	October	October	October	October	September	September
Number of samples	2	2	2	1	1	1	1
Flow in cubic feet per second:							
Sampling days	1.0	1.0	1.0	1.0	1.0	1.5	1.5
Minimum month							1.3
Water temperature, °C	20.5	12.0	10.8	20.0	21.0	19.0	19.0
Coliforms per milliliter	23,500	1,275	2,765	23	4	64	9
Dissolved oxygen, parts per million	5.2	2.7	1.6	2.5	5.6	6.2	4.4
Biochemical oxygen demand, 5-day, parts per million	6.7	4.6	16.2	3.5	3.2	2.5	3.8

At most stations in the basin, monthly average coliform results exceeding 200 per milliliter were observed during at least 1 month. High results were obtained from April to August 1939 and low results from September 1939 to April 1940. The most rapid coliform reduction in the stretches below sources of pollution occurred during the period August 1939 through January 1940, when discharges were low.

The dissolved oxygen results were generally more favorable than the coliform results. While complete oxygen depletion was observed below Lebanon and Bethel and monthly averages of less than 3.0 parts per million were observed below Wilmington, Jamestown, Xenia, Lynchburg, and at Beechmont, reaeration appears to bring about a recovery in dissolved oxygen within comparatively short distances below sources of pollution.

Maximum monthly average biochemical oxygen demand results of more than 5.0 parts per million were found at 49 percent of the stations in the basin. At 30 percent of the stations the highest monthly average was from 3.1 to 5.0 parts per million, and at 21 percent of the stations it was less than 3.0 parts per million. The highest results, 93, 46, and 43 parts per million, were observed below Wilmington, Lebanon, and Bethel, respectively. However, except below a few sources of pollution, such as Xenia and the above three municipalities, few results were in excess of 3.0 parts per million, so the picture as presented by the most unfavorable monthly average is somewhat darker than was actually the case over much of the sampling period.

Samples from Beechmont were influenced by sewage from the Cincinnati area. Results obtained during January 1940 over the entire basin were influenced by the extremely cold weather and by ice in the streams.

Biological summary.—The plankton of the Little Miami River were found to be abundant in species and numbers. The main stream is well supplied with fertilizer by the several small towns along its banks and average plankton volumes at the various sampling stations ranged from 2,000 to 6,000 parts per million. The plankton in the

tributaries was somewhat less except in Turtle Creek at South Lebanon where the population rose to 77,000 parts per million on 1 day.

HYDROMETRIC DATA

Of the three gaging stations in the basin, two are on the Little Miami at Milford and Spring Valley and one on East Fork at Perintown. Springs in headwaters influence critical low flows in the Little Miami, but flows in East Fork are extremely erratic, with long periods of near zero discharge.

TABLE LM–6.—*Little Miami River Basin; Monthly mean summer flows cubic feet per second at gaging stations for years in which low summer flows have occurred*

River	Little Miami	Little Miami	East Fork
Location	Above East Fork at Milford	Near town Spring Valley	Near town Perintown
River miles above:			
Confluence with Little Miami	----------	----------	6
Mouth of Little Miami	14	63	18
Drainage area, square miles	1,195	361	477
Period of record	1924–39	1925–36	1924–39
Year	1930	1930	1930
June, cubic feet per second	150	84	4.3
July, do	78	53	[1] 1.3
August, do	78	44	1.8
September, do	123	44	14
Year	1936	1932	1936
June, cubic feet per second	147	419	12
July, do	86	350	4.4
August, do	----------	61	19
September, do	----------	49	64
Year	1939	1934	1939
June, cubic feet per second	1,240	44	157
July, do	936	69	124
August, do	191	231	41
September, do	[1] 70	[1] 35	[1] 1.3

[1] Minimum flow.

Proposed stream control.—Five proposed flood-control reservoirs on the Little Miami River and its tributaries have been studied by the United States Engineer Department as follows:

Reservoir	Stream	Miles above mouth of Little Miami River
Washington Mills	Little Miami	68
Caesar Creek	Caesar Creek	53
Morrow	Little Miami	40
Todd Fork	Todd Fork	43
East Fork	East Fork	44

Increased low flow from these reservoirs would be beneficial to the extensive recreational uses of the Little Miami River and its tributaries. However, only the East Fork Reservoir would create tangible monetary benefits to pollution abatement by reducing the extent of treatment needed for pollution control.

Discussion

Pollution problems in the basin are minor and of local significance and can be solved by practical treatment methods. Industrial waste is limited to eight relatively small seasonal canneries and the waste problem can be corrected by chemical treatment or ponding with controlled diversion. All industrial waste is discharged to tributary streams.

Little Miami River below East Fork.—This section is the most highly polluted in the basin. Below mile 5 the Cincinnati metropolitan district contributes a population load of 129,000. Cincinnati is constructing intercepting sewers to divert this waste to a point of treatment with subsequent discharge direct to the Ohio River.

East Fork.—With extended periods of near zero flow on the East Fork (table Lm–6) the sources of pollution, although minor, will require fairly complete treatment to control local nuisance conditions during summer droughts. Normal stream uses are restricted to stock watering and limited recreation. Low stream discharges limit the value of the stream for recreation. At Batavia secondary treatment is needed and appears justified by stream uses below the outfall.

Primary treatment would be sufficient at Batavia if the proposed East Fork reservoir is operated for low-flow control incidental to flood control. Such operation would require no additional cost in reservoir construction and would ensure the adequacy of Batavia's public water supply taken from the East Fork. Intangible benefits would be substantial. The flows would provide dilution for residual pollution and would increase the recreational value of the lower East Fork and Little Miami Rivers.

Little Miami above East Fork.—Minor pollution problems exist due to inadequate waste treatment below Blanchester, Lebanon, Wilmington, and Xenia. These problems are purely local and can be corrected by secondary treatment at Blanchester and additions or improvements to existing facilities at the other three places.

Cost estimates for remedial measures are summarized in table Lm–1.

TABLE LM-7.—*Little Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Little Miami River, above South Charleston, Ohio.	Lm 99.5	Sept. 7, 1939	1	18.0	4.0	41.4	4.4	150	7.9			
Do	do	Oct. 4, 1939	1	16.0	7.5	75.7	2.5	460	7.9			
Do	do	Nov. 1, 1939	1	7.5	13.8	114.6	1.6	73	8.3			
Do	do	Dec. 12, 1939		2.0	16.6	120.1	1.6	15	8.0			
Do	do	Jan. 11, 1940		0	8.6	58.7	.6	9	7.7			
Little Miami River, below South Charleston, Ohio.	Lm 97.5	Sept. 7, 1939	1	19.5	6.6	70.7	1.5	36	7.9			
Do	do	Oct. 4, 1939	1	20.5	9.5	104.6	5.5	110	8.3			
Do	do	Nov. 1, 1939	1	8.0	12.1	101.6	2.2	75	8.3			
Do	do	Dec. 12, 1939		2.0	14.9	107.4	2.2	43	8.1			
Do	do	Jan. 11, 1940		0	12.2	83.4	.9	460	7.7			
Little Miami River, above Yellow Springs, Ohio.	Lm 84	July 28, 1939		24.0	7.4	87.3	.7	23				
Do	do	Aug. 25, 1939		21.5	8.1	91.4	.8	24	8.1			
Do	do	Sept. 22, 1939		14.0	7.4	71.1	1.0	46	7.9			
Do	do	Oct. 20, 1939		12.5	Lost		.9	8	7.7			
Do	do	Nov. 17, 1939		7.0	10.1	82.7	.6	1	7.6			
Do	do	Dec. 29, 1939		2.0	10.5	75.6	.4	2	7.7			
Little Miami River, below Yellow Springs, Ohio.	Lm 82	July 28, 1939	155	22.0	7.3	82.9	.8	36				
Do	do	Aug. 25, 1939	22	19.5	8.8	95.1	1.4	4	8.1			
Do	do	Sept. 22, 1939	14	14.0	8.5	81.8	1.3	24	8.0			
Do	do	Oct. 20, 1939	19	10.0	10.1	89.4	.8	4	7.9			
Do	do	Nov. 17, 1939	21	4.5	13.0	100.1	.5	1	7.9			
Do	do	Dec. 29, 1939		1.0	14.3	100.3	1.3	4	8.0			
Shawnee Creek, above Xenia, Ohio	LmS 80.6	June 22, 1939		25.0	8.0	95.2	1.4	460				
Do	do	June 29, 1939		22.0	7.3	93.1	2.9	1,100				
Do	do	July 17, 1939		18.5	6.2	65.7	1.2	36				
Do	do	July 28, 1939		24.5	6.8	80.2	1.6	73				
Do	do	Aug. 14, 1939		24.5	5.5	64.6	1.4	240	8.0			
Do	do	Aug. 25, 1939		17.5	4.5	46.3	1.8	93	8.1			
Do	do	Sept. 22, 1939		16.0	6.9	69.1	1.0	24	8.0			
Do	do	Oct. 20, 1939		12.5	7.5	70.2	1.3	4	7.9			
Do	do	Nov. 17, 1939		6.5	11.3	92.0	1.0	24	7.8			
Do	do	Dec. 29, 1939		1.0	11.7	82.0	1.0	4	7.8			

TABLE LM–7.—*Little Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Shawnee Creek, below Xenia, Ohio	LmS 78.1	June 22, 1939		24.0	6.6	78.0	6.4	4,600				
Do	do	June 29, 1939		21.5	7.3	81.6	5.3	11,000				
Do	do	July 17, 1939	3	19.0	7.1	75.9	1.8	360				
Do	do	July 28, 1939	3	24.5	6.1	72.2	1.8	360				
Do	do	Aug. 14, 1939	1	24.0	5.4	63.3	3.6	230	7.9			
Do	do	Aug. 25, 1939	1	17.5	2.4	25.3	3.7	1,500	7.3			
Do	do	Sept. 22, 1939	1	16.0	5.2	52.3	1.4	24	7.9			
Do	do	Oct. 20, 1939	1	13.0	2.6	24.9	5.4	46	7.6			
Do	do	Nov. 17, 1939	1	7.5	4.3	35.9	4.4	43	7.6			
Do	do	Dec. 29, 1939		1.0	5.6	39.4	11.0	230	7.5			
Shawnee Creek, below Xenia, Ohio	LmS 76.1	June 22, 1939		24.5	7.1	84.4	5.1	11,000				
Do	do	June 29, 1939		21.5	7.1	79.3	5.0	11,000				
Do	do	July 17, 1939		17.0	6.2	63.7	7.8	1,500				
Do	do	July 28, 1939		22.0	6.6	75.3	6.8	930				
Do	do	Aug. 14, 1939		23.5	6.5	75.9	7.2	930	8.0			
Do	do	Aug. 25, 1939		17.5	3.9	40.1	6.2	46,000	7.8			
Do	do	Sept. 22, 1939		15.0	6.9	67.7	6.8	240	8.0			
Do	do	Oct. 20, 1939		13.0	4.8	45.6	5.6	1,100	7.8			
Do	do	Nov. 17, 1939		8.0	6.3	52.8	5.7	750	7.7			
Do	do	Dec. 29, 1939		2.0	7.0	50.5	6.5	11,000	7.6			
Little Miami River, Waynesville, Ohio.	Lm 54	Feb. 20, 1939		7.5	10.4	86.2	3.8	150				
Do	do	Feb. 23, 1939		1.0	13.2	93.1	1.6	93				
Do	do	Feb. 28, 1939		6.5	11.8	96.0	3.6	93				
Do	do	Mar. 8, 1939		6.5	11.9	96.5	1.3	4				
Do	do	Mar. 16, 1939		7.5	10.8	99.5	.6	23				
Do	do	Mar. 24, 1939		11.5	10.7	98.0	.7	36				
Do	do	Mar. 28, 1939		9.0	11.8	101.8	1.5	43				
Do	do	Apr. 3, 1939		8.5	11.5	98.3	.6	4				
Do	do	Apr. 13, 1939		7.5	12.1	100.7	1.2	43				
Do	do	Apr. 19, 1939		8.5	10.6	90.3	2.0	93				
Do	do	Apr. 25, 1939		15.5	9.1	90.9	.9	75				
Do	do	May 5, 1939		14.0	10.1	97.7	1.0	9				
Do	do	May 11, 1939		15.5	8.9	88.5	1.1	24				
Do	do	May 15, 1939		16.0	9.7	97.6	1.2	15				
Do	do	May 23, 1939		21.5	8.0	90.0	1.3	3				
Do	do	May 29, 1939		21.5	7.5	84.1	1.8	46				
Do	do	June 8, 1939		23.5	7.3	84.9	1.3	15				

Do	do	June 14, 1939		16.5	8.4	84.9	5.0	1,100				
Do	do	Jan. 18, 1940		0	Lost		1.9	240	7.8			
Do	do	Jan. 31, 1940		0	12.5	85.5	.8	23	7.9			
Do	do	Feb. 8, 1940		1.0	12.7	89.5	5.4	230	7.6			
Do	do	Feb. 16, 1940		1.0	13.6	95.7	1.2	43	8.0			
Do	do	Feb. 23, 1940		3.5	12.9	97.0	1.0	210	7.8			
Do	do	Feb. 29, 1940		5.0	12.7	99.2	1.4	43	7.8			
Do	do	Mar. 6, 1940		4.0	12.2	92.8	1.5	240	7.6			
Do	do	Mar. 12, 1940		1.5	12.3	87.8	1.1	9	7.8			
Do	do	Mar. 18, 1940		13.0	12.1	114.0	.6	8	8.0			
Do	do	Mar. 26, 1940		8.0	13.5	113.7	1.0	4	7.8			
Do	do	Apr. 3, 1940		16.0	10.0	100.5	1.2	24	8.0			
South Caesar Creek, above Jamestown, Ohio.	LmC 83	Aug. 14, 1939		23.0	3.1	35.4	8.7	1,100				
Do	do	Aug. 25, 1939		18.0	3.4	35.8	3.1	36	7.5			
Do	do	Oct. 4, 1939		15.0	3.0	29.1	4.8	43	7.7			
Do	do	Nov. 1, 1939		5.0	3.2	25.2	4.5	9	7.5			
Do	do	Dec. 12, 1939		2.0	9.0	65.2	1.8	(1)	7.7			
Do	do	Jan. 11, 1940		0	1.7	11.6	1.3	1	7.5			
South Caesar Creek, below Jamestown, Ohio.	LmC 81.5	Aug. 14, 1939	1	22.5	1.8	21.1	5.0	460				
Do	do	Aug. 25, 1939	1	17.0	3.1	32.2	5.3	230	7.7			
Do	do	Oct. 4, 1939	1	12.0	3.4	31.4	5.3	4,600	7.6			
Do	do	Nov. 1, 1939	1	5.0	9.1	70.9	3.6	230	7.7			
Do	do	Dec. 12, 1939		1.5	13.5	96.2	2.4	23	8.1			
Do	do	Jan. 11, 1940		0	5.2	35.5	1.6	9	7.7			
Lyttle Creek, above Wilmington, Ohio.	LmL 66.5	June 21, 1939		23.5	7.2	84.3	5.7	2,400				
Do	do	June 29, 1939		23.5	7.9	91.7	1.5	240				
Do	do	July 17, 1939		18.0	9.1	95.2	1.0	230				
Do	do	July 27, 1939		24.5	8.9	105.3	1.4	91				
Do	do	Aug. 16, 1939		21.5	4.5	50.8	2.8	240	7.6			
Do	do	Sept. 5, 1939		18.5	.5	5.4	8.9	930				
Do	do	Oct. 2, 1939		15.0	3.8	27.6	3.5	2,400	7.5			
Do	do	Oct. 30, 1939		9.0	2.7	23.0	5.7	150	7.3			
Do	do	Dec. 8, 1939		3.0	9.1	67.5	2.1	36				
Do	do	Jan. 9, 1940		0	1.0	6.8	5.5	93				
Lyttle Creek, below Wilmington, Ohio.	LmL 59.5	June 21, 1939		24.0	7.9	92.4	2.2	230				
Do	do	June 29, 1939		23.5	7.6	87.8	3.7	1,500				
Do	do	July 17, 1939	2	21.5	12.9	144.8	1.4	36				
Do	do	July 27, 1939	2	25.5	9.5	114.8	4.4	430				
Do	do	Aug. 16, 1939	1	23.0	9.4	108.3	1.3	36	8.2			
Do	do	Sept. 5, 1939	1	18.5	8.9	94.3	6.1	93				
Do	do	Oct. 2, 1939	1	13.5	.2	2.0	23.4	4,600	7.7			
Do	do	Oct. 30, 1939	1	8.0	3.1	25.8	9.0	930	7.6			
Do	do	Dec. 8, 1939		5.0	.8	5.9	76.3	24,000				
Do	do	Jan. 9, 1940		1.0	2.3	16.2	93.1	110,000				
Todds Fork, Clarksville, Ohio	LmT 54	Feb. 20, 1939		7.5	10.4	86.4	5.6	150				
Do	do	Feb. 23, 1939		.5	13.7	95.2	1.2	43				
Do	do	Feb. 28, 1939		6.5	11.5	93.3	3.6	1,100				

[1] Less than 1.

TABLE LM-7.—*Little Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Todds Fork, Clarksville, Ohio	LmT 54	Mar. 8, 1939		4.5	12.9	99.3	.9	23				
Do	do	Mar. 16, 1939		5.0	12.0	93.6	.4	43				
Do	do	Mar. 24, 1939		11.0	11.4	103.2	4.8	30				
Do	do	Mar. 28, 1939		6.5	12.6	101.9	3.4	93				
Do	do	Apr. 3, 1939		7.0	11.9	98.1	.7	43				
Do	do	Apr. 13, 1939		6.0	13.1	105.3	1.0	75				
Do	do	Apr. 19, 1939		8.5	11.2	95.6	1.3	75				
Do	do	Apr. 25, 1939		15.0	9.9	97.7	.8	3				
Do	do	May 5, 1939		14.0	10.5	101.3	1.1	3				
Do	do	May 11, 1939		16.5	9.0	91.8	.7	2				
Do	do	May 15, 1939		16.0	9.6	96.2	.7	8				
Do	do	May 23, 1939		23.0	7.6	87.3	2.4	240				
Do	do	May 29, 1939		23.5	8.0	93.4	1.7	23				
Do	do	June 8, 1939		25.0	6.8	81.6	2.6	110				
Do	do	June 14, 1939		16.0	8.9	89.8	3.4	460				
Little Miami River, above mouth of Turtle Creek, South Lebanon, Ohio.	Lm 33.8	June 23, 1939		22.5	7.5	86.1	2.5	930				
Do	do	July 7, 1939		26.5	6.8	84.2	2.6	91				
Do	do	July 19, 1939		21.5	7.8	87.2	2.4	430				
Do	do	Aug. 2, 1939		23.5	7.4	86.0	1.0	91				
Do	do	Aug. 11, 1939		23.0	8.2	94.1	1.3	36				
Do	do	Aug. 30, 1939		22.0	7.8	87.9	1.6	15	8.1			
Do	do	Sept. 27, 1939		18.5	8.0	84.4	1.6	9	7.9			
Do	do	Oct. 25, 1939		13.5	9.3	88.6	1.5	4	7.9			
Do	do	Nov. 22, 1939		5.5	11.5	90.7	1.3	2	8.0			
Do	do	Jan. 4, 1940		0	14.0	96.0	.9	1	8.0			
Turtle Creek, above Lebanon, Ohio	LmTu 41.6	June 23, 1939		21.0	7.8	86.4	1.3	150				
Do	do	July 7, 1939		26.5	6.6	81.0	2.5	390				
Do	do	July 19, 1939		21.5	6.5	73.0	2.1	230				
Do	do	Aug. 2, 1939		23.5	6.7	77.4	1.0	230				
Do	do	Aug. 11, 1939		21.0	6.2	69.0	1.3	91				
Do	do	Aug. 30, 1939		18.5	5.4	57.4	4.6	93	7.6			
Do	do	Sept. 27, 1939		15.0	5.6	55.3	1.4	5	7.5			
Do	do	Nov. 22, 1939		8.0	8.0	67.4	2.0	2	7.5			
Do	do	Jan. 4, 1940		1.0	5.0	35.1	.9	4	7.9			

Turtle Creek, above sewage, Lebanon, Ohio.	LmTu 39.6	June 23, 1939	-----	21.5	7.3	82.2	1.7	36	-----	-----	-----	-----
Do	do	July 7, 1939	-----	25.5	6.6	79.5	2.6	91	-----	-----	-----	-----
Do	do	July 19, 1939	-----	21.5	6.4	72.4	2.4	430	-----	-----	-----	-----
Do	do	Aug. 2, 1939	-----	22.5	5.5	63.3	1.4	430	-----	-----	-----	-----
Do	do	Aug. 11, 1939	-----	21.5	2.4	27.2	5.9	11,000	-----	-----	-----	-----
Do	do	Aug. 30, 1939	-----	20.0	0	0	35.3	93,000	-----	-----	-----	-----
Do	do	Sept. 27, 1939	-----	17.0	0	0	18.3	43,000	7.5	-----	-----	-----
Do	do	Oct. 25, 1939	-----	13.0	3.4	32.4	4.4	360	7.6	-----	-----	-----
Do	do	Nov. 22, 1939	-----	7.0	.2	1.8	45.9	24,000	7.5	-----	-----	-----
Do	do	Jan. 4, 1940	-----	0	7.4	50.6	6.9	91	7.9	-----	-----	-----
Do	do	Jan. 24, 1940	-----	2.0	5.8	41.8	.8	9	7.5	-----	-----	-----
Turtle Creek, below Lebanon, Ohio	LmTu 37.8	Feb. 20, 1939	-----	8.0	10.4	88.0	2.7	240	-----	-----	-----	-----
Do	do	Feb. 23, 1939	-----	3.0	12.4	91.7	2.3	460	-----	-----	-----	-----
Do	do	Feb. 28, 1939	-----	8.0	11.0	92.4	3.2	1,100	-----	-----	-----	-----
Do	do	Mar. 8, 1939	-----	7.0	11.9	97.8	1.0	93	-----	-----	-----	-----
Do	do	Mar. 16, 1939	-----	6.0	10.9	87.5	2.2	93	-----	-----	-----	-----
Do	do	Mar. 24, 1939	-----	13.0	8.5	80.3	2.1	2,400	-----	-----	-----	-----
Do	do	Mar. 28, 1939	-----	6.5	12.0	97.0	2.6	460	-----	-----	-----	-----
Do	do	Apr. 3, 1939	-----	8.5	11.3	96.2	.7	91	-----	-----	-----	-----
Do	do	Apr. 13, 1939	-----	6.0	12.3	98.6	1.4	93	-----	-----	-----	-----
Do	do	Apr. 19, 1939	-----	8.0	10.8	91.2	2.9	1,100	-----	-----	-----	-----
Do	do	Apr. 25, 1939	-----	15.0	8.8	86.7	1.2	240	-----	-----	-----	-----
Do	do	May 5, 1939	-----	14.5	11.9	115.6	2.6	930	-----	-----	-----	-----
Do	do	May 11, 1939	-----	15.0	7.1	70.0	2.6	2,400	-----	-----	-----	-----
Do	do	May 15, 1939	-----	15.5	8.5	84.6	3.7	930	-----	-----	-----	-----
Do	do	May 23, 1939	-----	22.0	5.3	60.0	7.5	2,400	-----	-----	-----	-----
Do	do	May 29, 1939	-----	21.5	5.0	56.1	4.4	11,000	-----	-----	-----	-----
Do	do	June 8, 1939	3	24.5	2.7	31.7	7.6	11,000	-----	-----	-----	-----
Do	do	June 14, 1939	3	17.5	7.4	76.8	4.1	750	-----	-----	-----	-----
Do	do	June 23, 1939	3	22.0	5.1	57.8	2.1	36	-----	-----	-----	-----
Do	do	July 7, 1939	2	25.5	5.0	59.8	2.6	750	-----	-----	-----	-----
Do	do	July 19, 1939	2	21.5	4.7	52.7	2.3	2,400	-----	-----	-----	-----
Do	do	Aug. 2, 1939	1	21.0	3.8	42.7	2.8	4,600	-----	-----	-----	-----
Do	do	Aug. 11, 1939	1	20.5	1.0	10.5	7.4	240,000	-----	-----	-----	-----
Do	do	Aug. 30, 1939	1	19.0	0	0	79.3	150,000	7.5	-----	-----	-----
Do	do	Sept. 27, 1939	1	17.0	0	0	46.0	240,000	7.5	-----	-----	-----
Do	do	Oct. 25, 1939	2	13.5	0	0	38.0	23,000	7.5	-----	-----	-----
Do	do	Nov. 22, 1939	1	7.0	1.2	9.9	15.7	15,000	7.5	-----	-----	-----
Do	do	Jan. 4, 1940	-----	0	2.9	20.1	55.0	2,300	7.8	-----	-----	-----
Do	do	Jan. 24, 1940	-----	0	7.2	48.9	29.2	11,000	7.5	-----	-----	-----
Do	LmTu 34.2	June 23, 1939	-----	21.5	7.2	80.8	1.9	230	-----	-----	-----	-----
Do	do	July 7, 1939	-----	25.5	6.5	78.8	2.9	930	-----	-----	-----	-----
Do	do	July 19, 1939	-----	21.0	7.1	79.2	2.5	230	-----	-----	-----	-----
Do	do	Aug. 2, 1939	-----	22.5	7.3	83.1	1.2	150	-----	-----	-----	-----
Do	do	Aug. 11, 1939	-----	20.5	7.2	78.7	1.8	30	-----	-----	-----	-----
Do	do	Aug. 30, 1939	-----	19.5	5.8	63.2	2.5	7	7.9	-----	-----	-----
Do	do	Sept. 27, 1939	-----	16.5	6.6	67.0	5.4	24	7.9	-----	-----	-----
Do	do	Oct. 25, 1939	-----	13.0	7.0	65.6	2.2	23	7.9	-----	-----	-----
Do	do	Nov. 22, 1939	-----	4.5	9.0	69.8	3.9	24	7.8	-----	-----	-----
Do	do	Jan. 4, 1940	-----	0	10.1	69.1	1.2	2	7.9	-----	-----	-----
Do	do	Jan. 24, 1940	-----	0	8.4	57.6	13.1	1,100	7.5	-----	-----	-----

TABLE LM–7.—*Little Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Little Miami River, Kings Mills, Ohio.	Lm 31.2	June 23, 1939		22.5	7.8	89.4	2.3	230				
Do	do	July 7, 1939		26.0	7.2	87.2	2.5	150				
Do	do	July 19, 1939		21.5	8.0	89.2	1.8	430				
Do	do	Aug. 2, 1939		24.5	7.8	92.7	1.0	36				
Do	do	Aug. 11, 1939		24.0	8.9	104.5	1.8	9				
Do	do	Aug. 30, 1939		22.0	8.3	93.7	1.5	9	8.1			
Do	do	Sept. 27, 1939		19.5	8.2	88.0	1.3	4	8.1			
Do	do	Oct. 25, 1939		13.5	9.2	87.7	1.5	2	8.0			
Do	do	Nov. 22, 1939		6.5	11.3	92.0	1.4	4	7.9			
Do	do	Jan. 4, 1940		0	13.9	94.9	.6	240	8.0			
Little Miami River, Foster, Ohio	Lm 28.6	Feb. 20, 1939		8.5	10.4	88.7	3.8	1,100				
Do	do	Feb. 23, 1939		0	Broken		2.0	93				
Do	do	Feb. 28, 1939		6.5	12.2	99.0	2.5	150				
Do	do	Mar. 8, 1939		6.0	12.2	97.4	.9	43				
Do	do	Mar. 16, 1939		7.0	11.1	90.9	.9	23				
Do	do	Mar. 24, 1939		11.0	10.9	98.3	.6	30				
Do	do	Mar. 28, 1939		7.0	12.3	100.8	4.2	240				
Do	do	Apr. 3, 1939		7.5	11.6	96.3	.8	36				
Do	do	Apr. 13, 1939		7.0	12.0	99.0	1.3	460				
Do	do	Apr. 19, 1939		9.5	10.8	93.8	2.1	150				
Do	do	Apr. 25, 1939		15.5	9.7	96.1	.7	23				
Do	do	May 5, 1939		14.5	10.4	101.3	1.2	9				
Do	do	May 11, 1939		17.5	9.3	96.8	1.2	2				
Do	do	May 15, 1939		16.0	9.4	94.5	1.4	2				
Do	do	May 23, 1939		23.0	7.6	88.0	1.1	2				
Do	do	May 29, 1939		23.5	6.4	75.0	1.9	46				
Do	do	June 8, 1939		25.0	7.1	85.1	1.5	9				
Do	do	June 14, 1939		16.5	8.0	81.0	4.1	1,100				
Do	do	Jan. 18, 1940		0	Lost		3.5	460	7.6			
Do	do	Jan. 31, 1940		0	12.9	88.2	1.6	43	8.0			
Do	do	Feb. 8, 1940		1.0	11.9	83.8	6.8	230	7.5			
Do	do	Feb. 16, 1940		1.5	14.1	100.3	1.7	43	7.9			
Do	do	Feb. 23, 1940		2.5	13.6	99.7	1.1	43	7.8			
Do	do	Feb. 29, 1940		4.0	13.6	103.4	3.0	150	7.7			
Do	do	Mar. 6, 1940		4.0	12.8	97.5	1.7	93	7.6			
Do	do	Mar. 12, 1940		3.0	12.6	93.5	.6	9	7.9			
Do	do	Mar. 18, 1940		12.0	11.6	107.1	.6	1	7.9			
Do	do	Mar. 26, 1940		6.5	13.5	109.6	.9	2	8.2			
Do	do	Apr. 3, 1940		16.0	9.3	93.7	1.6	93	8.0			

Little Miami River, above Loveland, Ohio.	Lm 24.6	June 22, 1939		24.0	7.1	82.9	4.1	2,400				
Do	do	June 29, 1939		23.5	7.2	84.1	2.8	1,100				
Do	do	July 17, 1939		24.0	10.7	125.8	2.7	36				
Do	do	July 28, 1939		26.0	6.5	79.3	4.1	2,100				
Do	do	Aug. 28, 1939		22.5	7.9	90.3	1.7	36	8.1			
Do	do	Sept. 25, 1939		20.0	9.4	102.7	4.5	5	7.9			
Do	do	Oct. 23, 1939		12.0	9.7	89.6	1.8	9	8.0			
Do	do	Nov. 20, 1939		6.5	12.2	99.0	2.0	1	8.0			
Do	do	Jan. 2, 1940		0	15.5	105.8	.8	(1)	8.0			
Little Miami River below Loveland, Ohio.	Lm 23.6	July 28, 1939	1,455	25.0	6.4	76.6	4.3	4,600				
Do	do	Aug. 28, 1939	89	22.5	7.9	90.6	1.7	36	8.1			
Do	do	Sept. 25, 1939	57	19.5	9.7	105.0	3.6	5	8.2			
Do	do	Oct. 23, 1939	58	12.0	9.7	89.6	1.8	2	8.0			
Do	do	Nov. 20, 1939	93	7.0	11.9	97.8	1.1	2	8.0			
Do	do	Jan. 2, 1940		0	15.0	102.9	.6	24	8.0			
Do	Lm 22.0	June 22, 1940		24.0	7.1	83.4	3.7	1,100				
Do	do	June 29, 1940		23.5	7.1	82.3	3.8	1,100				
Do	do	July 17, 1940	1,455	25.0	10.7	127.7	3.1	36				
Little Miami River, above Milford, Ohio.	Lm 14.2	Aug. 28, 1939		23.5	7.9	92.1	2.6	3	8.1			
Do	do	Sept. 26, 1939		20.5	8.4	92.2	3.9	5	7.9			
Do	do	Oct. 23, 1939		12.5	9.5	88.7	2.5	1	8.1			
Do	do	Nov. 20, 1939		7.0	11.8	97.3	1.3	24	8.0			
Do	do	Jan. 2, 1940		0	15.5	105.8	0	43	8.0			
Little Miami River, below Milford, Ohio.	Lm 13.5	Feb. 20, 1939	12,100	8.5	10.4	89.1	3.7	75				
Do	do	Feb. 23, 1939	1,700	0	Broken		1.3	43				
Do	do	Feb. 28, 1939		6.5	12.4	101.0	2.2	43				
Do	do	Mar. 8, 1939	1,100	5.0	11.2	87.1	1.0	43				
Do	do	Mar. 16, 1939	1,300	6.0	11.0	84.5	1.0	9	8.2	63	202	
Do	do	Mar. 24, 1939	400	9.5	10.9	95.1	1.2	30	8.0	7	254	
Do	do	Mar. 28, 1939	4,700	6.0	12.1	97.0	4.5	240	8.2	600	91	
Do	do	Apr. 3, 1939	1,100	7.0	11.5	94.2	.9	30	8.0	38	203	
Do	do	Apr. 13, 1939	1,400	6.0	11.7	93.8	1.9	93	7.9	120	176	
Do	do	Apr. 19, 1943	4,800	9.5	10.5	91.4	2.6	460	7.7	260	142	
Do	do	Apr. 25, 1939	1,100	14.0	9.6	92.9	1.0	9	8.0	35	229	
Do	do	May 5, 1939	500	14.0	10.6	101.8	1.1	3	8.0	17	237	
Do	do	May 11, 1939	400	17.5	8.8	91.2	1.2	2	7.6	8	157	
Do	do	May 15, 1939	300	15.5	8.8	87.1	.9	2	8.1	5	231	
Do	do	May 23, 1939	300	22.0	7.9	89.2	2.7	4	7.7	450	82	
Do	do	May 29, 1939	270	23.5	7.2	84.1	2.3	46	8.1	55	214	
Do	do	June 8, 1939	120	24.5	7.4	87.8	1.4	24	8.4	117	175	
Do	do	June 14, 1939	2,365	17.0	8.7	88.9	4.7	1,100	8.5	775	52	
Do	do	June 22, 1939	3,760	24.0	6.6	77.0	3.6	2,100	7.7	950	86	
Do	do	June 30, 1939	7,360	23.0	7.0	80.3	2.7	930				
Do	do	July 18, 1939	118	23.0	8.0	92.2	1.8	150				
Do	do	July 31, 1939	210	22.5	7.5	86.1	1.4	93				

[1] Less than 1.

TABLE LM-7.—*Little Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Little Miami River, below Milford, Ohio.	Lm 13.5	Aug. 15, 1939	165	26.5	7.1	87.2	1.9	230				
Do	do	Jan. 18, 1940	311	0	Lost		2.7	460	7.7			
Do	do	Jan. 31, 1940	119	0	12.6	86.2	7.5	43	7.9			
Do	do	Feb. 8, 1940	791	1.0	13.4	93.9	7.1	210	7.5			
Do	do	Feb. 16, 1940	564	1.0	13.9	97.5	1.9	23	7.9			
Do	do	Feb. 23, 1940	739	1.5	13.5	96.4	1.1	93	7.8			
Do	do	Feb. 29, 1940	1,190	3.0	13.5	99.9	1.5	43	7.8			
Do	do	Mar. 6, 1940	2,440	3.0	12.5	93.0	1.5	150	7.6			
Do	do	Mar. 12, 1940	530	3.0	12.7	94.4	1.1	9	7.9			
Do	do	Mar. 18, 1940	505	10.0	11.7	103.4	.8	2	8.0			
Do	do	Mar. 26, 1940	306	6.0	13.5	108.1	.9	2	8.2			
Do	do	Apr. 3, 1940	600	16.0	10.0	101.0	1.5	4	8.1			
Do	Lm 13.3	Aug. 28, 1939	226	23.5	9.0	104.3	2.9	23	8.2			
Do	do	Sept. 25, 1939	115	20.0	8.0	87.0	3.1	46	8.0			
Do	do	Oct. 23, 1939	123	12.5	10.2	94.8	2.2	23	8.1			
Do	do	Nov. 20, 1939	209	6.0	11.6	92.8	1.3	93	8.0			
Do	do	Jan. 2, 1940	171	0	14.8	101.1	.7	7	8.0			
Turtle Creek, above Lynchburg, Ohio.	LmEfT 81	Oct. 9, 1939		21.5	3.9	44.1	5.1	36	7.9			
Do	do	Nov. 6, 1939		6.0	4.2	33.4	4.7	21	7.5			
Do	do	Dec. 15, 1939		2.5	13.5	99.0	3.4	9	7.8			
Do	do	Jan. 25, 1940		0	12.8	87.3	4.4	9	7.5			
East Fork, Little Miami River, above Lynchburg, Ohio.	LmEf 81	Oct. 9, 1939	1	20.0	2.5	27.6	3.5	23	7.7			
Do	do	Nov. 6, 1939	1	3.0	6.8	50.7	2.0	4	7.6			
Do	do	Dec. 15, 1939		1.5	11.9	85.0	1.4	2	7.9			
Do	do	Jan. 25, 1940		0	9.2	63.3	1.1	4	7.5			
East Fork, Little Miami River, below Lynchburg, Ohio.	LmEf 80	Oct. 9, 1939	1	21.0	5.6	61.8	3.2	4	7.8			
Do	do	Nov. 6, 1939	1	5.0	10.3	80.5	1.8	240	7.8			
Do	do	Dec. 15, 1939		1.5	10.8	77.0	1.6	93	7.8			
Do	LmEf 80	Jan. 25, 1940		0	10.0	68.7	.9	46	7.6			
East Fork Little Miami River, above Williamsburg, Ohio.	LmEf 46.2	June 21, 1939		25.0	6.6	78.4	2.1	23				
Do	do	June 30, 1939		25.0	7.0	83.5	.7	36				
Do	do	July 18, 1939		22.5	6.8	78.1	2.6	93				
Do	do	July 31, 1939		24.0	7.1	83.7	1.2	15				
Do	do	Aug. 15, 1939		26.0	6.2	75.2	2.4	24				

Do	do	Aug. 29, 1939		22.5	6.5	74.5	2.1	5	7.5			
Do	do	Sept. 26, 1939		19.0	8.0	85.9	3.4	29	7.7			
Do	do	Oct. 24, 1939		11.5	8.8	80.2	2.4	2	7.6			
Do	do	Nov. 21, 1939		6.5	10.4	84.2	3.5	2	7.6			
Do	do	Jan. 3, 1940		0	12.8	87.5	1.6	2	7.9			
East Fork Little Miami River, below Williamsburg, Ohio.	LmEf 45.0	June 21, 1939		26.5	7.1	87.0	1.5	91				
Do	do	June 30, 1939		25.0	7.2	85.7	1.7	36				
Do	do	July 18, 1939		22.0	6.7	76.1	5.7	1,100				
Do	do	July 31, 1939		23.5	7.5	87.4	1.4	91				
Do	do	Aug. 15, 1939		27.0	6.0	74.1	2.1	46				
Do	do	Aug. 29, 1939		22.0	6.9	78.1	1.8	240	7.6			
Do	do	Sept. 26, 1939	1	20.0	6.2	67.2	3.9	240	7.5			
Do	do	Oct. 24, 1939	3	12.0	8.1	75.1	4.0	23	7.5			
Do	do	Nov. 21, 1939	7	6.0	6.5	52.1	11.0	1,100	7.4			
Do	do	Jan. 3, 1940		0	13.6	92.8	3.1	73	7.8			
Town Run, above Bethel, Ohio	LmEfTo 44.5	Aug. 1, 1939		21.5	3.8	42.3	2.2	93				
Do	do	Sept. 11, 1939		17.5	1.8	18.7	5.1	430				
Town Run, below Bethel, Ohio	LmEfTo 43	Aug. 1, 1939		22.0	3.7	42.2	3.7	1,100				
Do	do	Sept. 11, 1939		17.5	0	0	42.6	15,000				
East Fork, Little Miami River, above Batavia, Ohio.	LmEf 25	June 21, 1939		27.0	7.5	93.2	1.8	75				
Do	do	June 30, 1939		24.0	7.3	85.6	2.0	91				
Do	do	July 18, 1939		23.5	7.4	86.0	2.5	1,100				
Do	do	July 31, 1939		23.5	8.3	96.5	1.5	36				
Do	do	Aug. 15, 1939		26.5	7.2	89.1	1.7	110				
Do	do	Aug. 29, 1939		21.5	7.7	86.4	1.5	110	7.9			
Do	do	Sept. 26, 1939		19.0	6.2	66.3	2.5	64	7.7			
Do	do	Oct. 24, 1939		11.5	5.2	47.2	7.2	2,400	7.5			
Do	do	Nov. 21, 1939		6.0	10.4	83.1	4.5	4,600	7.6			
Do	do	Jan. 3, 1940		0	15.0	102.3	1.3	36	7.9			
East Fork, Little Miami River, below Batavia, Ohio.	LmEf 24.2	July 18, 1939		23.5	5.8	67.8	3.0	2,400				
Do	do	July 31, 1939		23.5	7.0	81.6	1.4	430				
Do	do	Aug. 15, 1939		25.5	4.5	54.5	1.8	460				
Do	do	Aug. 29, 1939		23.0	7.6	87.7	2.3	39	7.6			
Do	do	Sept. 26, 1939	2	19.0	4.4	47.4	3.8	9	7.5			
Do	do	Oct. 24, 1939	4	11.0	8.4	76.0	8.3	4	7.9			
Do	do	Nov. 21, 1939	10	6.5	4.9	40.0	3.4	46	7.5			
Do	do	Jan. 3, 1940		0	13.4	91.5	5.1	240	7.8			
Do	do	June 21, 1939		27.0	7.2	88.7	1.6	36				
Do	do	June 30, 1939		24.0	6.8	79.7	2.1	430				
East Fork Little Miami River at mouth.	LmEf 12.7	May 11, 1939		18.0	8.4	88.6	2.1	9				
Do	do	May 15, 1939		16.5	8.6	87.7	2.2	4				
Do	do	May 23, 1939		21.0	5.9	65.6	2.3	240				
Do	do	May 29, 1939		24.5	7.7	91.6	3.6	30				
Do	do	June 8, 1939		24.5	5.9	69.5	2.7	110				
Do	do	June 14, 1939		19.0	6.5	69.7	2.1	43				
Do	do	June 21, 1939		24.5	6.7	78.9	1.8	240				
Do	do	June 30, 1939		22.5	6.6	75.7	3.2	930				

TABLE LM-7.—*Little Miami River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
East Fork Little Miami River at mouth.	LmEf 12.7	July 18, 1939		23.5	7.3	84.5	1.8	73				
Do	do	July 31, 1939		23.0	6.2	71.5	1.8	43				
Do	do	Aug. 15, 1939		26.5	6.8	83.3	2.8	36				
Do	do	Aug. 29, 1939		22.5	5.6	64.3	2.4	46	7.6			
Do	do	Sept. 26, 1939	2	20.0	8.7	94.7	2.0	24	7.7			
Do	do	Oct. 24, 1939	6	13.0	7.8	73.6	2.7	2	7.7			
Do	do	Nov. 21, 1939	14	7.5	11.2	93.5	2.2	2	7.6			
Do	do	Jan. 3, 1940		0	13.1	89.3	3.2	8	7.8			
Do	do	Jan. 18, 1940		0	Lost		4.2	93	7.7			
Do	do	Jan. 24, 1940		0	11.3	77.3	2.3	36	7.5			
Do	do	Jan. 30, 1940		0	10.1	69.2	3.1	2	7.7			
Do	do	Feb. 8, 1940		0	13.0	89.0	7.4	230	7.5			
Do	do	Feb. 16, 1940		0	13.4	91.5	4.4	93	7.5			
Do	do	Feb. 23, 1940		2.0	13.2	95.5	2.6	20	7.5			
Do	do	Feb. 29, 1940		3.5	13.3	99.9	3.1	43	7.5			
Do	do	Mar. 6, 1940		3.5	11.5	86.7	2.4	43	7.4			
Do	do	Mar. 12, 1940		3.0	11.7	86.8	1.4	11	7.8			
Do	do	Mar. 18, 1940		10.0	10.8	95.0	.9	24	7.7			
Do	do	Mar. 26, 1940		7.0	11.9	97.6	.9	1	7.6			
Do	do	Apr. 3, 1940		15.5	9.0	89.9	1.7	24	7.7			
Little Miami River, Plainville Bridge	Lm 8.3	Jan. 1939			14.4		1.8		8.2	25	230	
Little Miami River, Clare Bridge	Lm 7.5	do			13.1		1.6		8.1	36	155	
Little Miami River, Beechmont Bridge.	Lm 4.3	Jan. 12, 1939			12.4		5.1		8.2	25	123	
Do	do	Jan. 13, 1939			12.6		4.7		8.0	25	216	
Do	do	Jan. 16, 1939			12.8		2.8		8.3	25		
Do	do	Jan. 17, 1939			12.8		2.4		8.3	25	197	
Do	do	Jan. 18, 1939			12.8		2.2		8.2	25		
Do	do	Jan. 19, 1939			12.8		2.6		8.1	36	142	
Do	do	Jan. 20, 1939			13.0		1.5		8.1	25	146	
Do	do	Jan. 23, 1939			13.2		1.9		8.0	96	140	
Do	do	Feb. 23, 1939	2,500	0	Broken		2.2	240				
Do	do	Feb. 28, 1939	13,500	5.0	12.5	97.5	1.9	240				
Do	do	Mar. 8, 1939	1,620	5.5	12.0	94.7	1.6	43				
Do	do	Mar. 16, 1939	2,350	6.0	10.5	83.8	.8	39				
Do	do	Mar. 24, 1939	588	9.5	10.6	92.8	.5	30				
Do	do	Mar. 28, 1939	6,910	5.5	12.0	94.5	4.8	240				
Do	do	Apr. 3, 1939	1,610	7.0	11.0	90.6	1.3	230				

Do	do	Apr. 13, 1939	2,060	5.5	11.3	89.6	2.4	240					
Do	do	Apr. 19, 1939	7,050	10.0	9.5	84.2	2.0	460					
Do	do	Apr. 25, 1939	1,610	14.5	8.8	85.8	1.3	460					
Do	do	May 5, 1939	734	13.5	10.2	97.2	2.0	91					
Do	do	May 11, 1939	587	18.0	7.5	78.4	2.8	430					
Do	do	May 15, 1939	441	16.0	7.8	78.0	2.4	2,400					
Do	do	May 23, 1939	441	21.5	6.5	73.0	4.2	930					
Do	do	May 29, 1939	397	23.0	6.1	70.5	3.1	750					
Do	do	June 8, 1939	176	24.0	5.6	65.7	3.4	4,600					
Do	do	June 14, 1939	3,470	17.5	7.2	74.8	5.9	2,400					
Do	do	June 22, 1939	5,520	24.5	5.4	64.1	3.6	930					
Do	do	June 30, 1939	10,800	23.0	6.8	78.7	None	2,400					
Do	do	July 18, 1939	174	21.0	4.5	50.4	13.1	4,600					
Do	do	July 31, 1939	308	22.5	6.9	78.9	2.1	4,600					
Do	do	Aug. 15, 1939	228	25.5	3.8	46.4	4.0	4,300	7.7				
Do	do	Aug. 28, 1939	154	23.5	7.7	90.0	4.6	2,300	7.8				
Do	do	Sept. 11, 1939	87	20.0	3.0	33.2	10.6	430					
Do	do	Sept. 25, 1939	78	19.5	1.5	16.5	1.6	4,600	7.5				
Do	do	Oct. 9, 1939	79	19.5	2.5	27.0	7.8	11,000	7.7				
Do	do	Oct. 23, 1939	84	11.5	4.0	37.0	8.0	2,300	7.5				
Do	do	Nov. 6, 1939	134	6.0	9.1	73.1	9.4	4,300	7.6				
Do	do	Nov. 20, 1939	142	8.0	6.7	56.3	13.6	4,600	7.6				
Do	do	Dec. 15, 1939	167	3.5	12.0	90.0	7.5	1,100	7.9				
Do	do	Jan. 2, 1940	120	0	12.5	85.5	5.6	2,100	7.7				
Do	do	Jan. 18, 1940	456	0	Lost		3.5	2,400	7.7	170			
Do	do	Jan. 24, 1940	308	0	12.6	86.0	5.0	2,400	7.6				
Do	do	Jan. 31, 1940	175	0	11.8	80.8	5.1	4,600	7.9				
Do	do	Feb. 8, 1940	1,160	3.0	13.0	96.7	8.1	930	7.6				
Do	do	Feb. 16, 1940	828	1.0	13.7	96.3	1.5	36	7.9				
Do	do	Feb. 23, 1940	1,085	2.0	Lost			460					
Do	do	Feb. 29, 1940	1,750	2.0	13.3	96.0	1.3	150	7.8				
Do	do	Mar. 6, 1940	3,580	3.5	12.0	90.2	2.5	93	7.5				
Do	do	Mar. 12, 1940	779	4.0	12.1	92.2	3.2	1,100	7.5				
Do	do	Mar. 18, 1940	742	9.0	11.6	100.3	.9	9	7.8				
Do	do	Mar. 26, 1940	449	7.0	12.2	100.6	1.6	93	8.0				
Do	do	Apr. 3, 1940	881	15.0	9.8	96.8	1.6	93	8.1				
Do	do	Apr. 23, 1940		8.0			2.5	93	7.5	320	85		
Do	do	Apr. 24, 1940		8.0			1.9	460	7.6	270	84		
Do	do	Apr. 25, 1940		10.0				93	7.8	140	109		
Do	do	Apr. 26, 1940		10.0			1.5	75	7.7	100	22		
Do	do	Apr. 29, 1940		13.5			1.2	75	7.7		197		
Do	do	Apr. 30, 1940		13.5			1.8	1,100	7.8	35	212		
Do	do	May 1, 1940		15.0			2.4	240	7.8	160	220		
Do	do	May 2, 1940		11.0			2.6	240	7.8	160	227		
Do	do	May 3, 1940		10.0			2.2	460	7.8	65	230		
Do	do	May 6, 1940					1.9		7.8	15	228		

KENTUCKY RIVER BASIN

CONTENTS

	Page
Contents	669
Syllabus and conclusions	671
Description	672
Presentation of field data	673
Presentation of laboratory data	676
Hydrometric data	677
Discussion	678

LIST OF TABLES

Ky–1.—Cost estimates of remedial measures	672
Ky–2.—Surface-water supplies	674
Ky–3.—Sources of pollution	674
Ky–4.—Industrial wastes	675
Ky–5.—Selected laboratory data	676
Ky–6.—Monthly mean summer flows	678
Ky–7.—Summary of laboratory data	680

LIST OF FIGURES

Ky–1.—Map—Sources of pollution	671
Ky–2.—Chart—Sources of pollution and selected laboratory data	674
Ky–3.—Map—Coliform results	676
Ky–4.—Map—Dissolved oxygen results	676
Ky–5.—Map—Biochemical oxygen demand results	676

Fig. Ky-1

KENTUCKY - LICKING - SALT BASINS

SOURCES OF POLLUTION

Fig. Ky-1

(Face p. 671) GPO-43 O-9035

KENTUCKY RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Kentucky River Basin (drainage area 6,940 square miles) comprises parts of the mountains of eastern Kentucky and of the Bluegrass area in the central part of the State. Agriculture and coal mining are the principal industries and the area is predominantly rural. Of the total population of 480,000, only 20 percent is urban. The pollution problems are primarily of local interest and much has been done already toward pollution abatement. About two-thirds of the population of 105,000 served by sewers are connected to treatment plants. The principal waste-producing industry, whisky distilling, accounts for almost 90 percent of the industrial waste load discharged to the streams. All of the distilleries have adopted corrective measures of one kind or another to reduce pollution. Acid mine drainage damages a number of the creeks in the mountainous area, but none of the large streams are acid. Abatement of pollution can be effected by known methods of treatment.

CONCLUSIONS

(1) Although 10 public water supplies are taken from streams below sources of pollution, at only one of them, Irvine, is pollution serious. Correction of this situation will probably require changes in the water system in addition to waste treatment.

(2) A total of 105,000 people are connected to sewers, of which about 65 percent are tributary to treatment plants. Industrial wastes, chiefly from distilleries, have a sewered population equivalent of about 130,000, of which about one-third is connected to municipal treatment.

(3) The laboratory observations indicate that, except below Irvine and Frankfort, the main Kentucky River is not seriously polluted. Gross pollution followed by rapid recovery is indicated below communities on tributaries. Distilleries were not all in operation at the time of sampling. Acid mine drainage was encountered on certain headwater streams.

(4) Minimum monthly flows of 91.3 and 15.8 cubic feet per second were experienced in 1930 on the main Kentucky River at Frankfort and near Winchester, respectively. Eliminating 1930, the low flows are 350 and 55 cubic feet per second respectively.

(5) Proposed flood-control reservoir sites studied by the United States Engineer Department are so located as to be of little tangible benefit to pollution control.

90035—44—pt. 2——34

(6) Most of the sources of pollution are on tributary streams which are subject to extremely low flows. Secondary treatment of wastes is necessary at these places and has already been installed at many of them. In general, primary treatment will be adequate on the main river.

(7) The principal sources of industrial wastes are the whisky distilleries. Most of these operate only during the winter months when temperatures are low and stream flows high. Those which operate throughout the year cause the most serious pollution. Rather complete treatment is needed at these plants.

(8) A summary of cost estimates of remedial measures from table Ky–1 follows:

Treatment	Capital cost	Annual cost
Existing	$1,370,000	$155,000
Suggested additional	1,490,000	160,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin, are—

Treatment	Capital cost	Annual cost
Primary, all places	$1,300,000	$135,000
Secondary, all places	1,600,000	170,000

TABLE Ky–1.—*Kentucky River Basin: Estimated cost of existing and suggested minimum corrective measures for municipal and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	3	10	69,400	$1,370,000	$95,000	$60,000	$155,000
Suggested minimum correction:							
Sewage treatment plants	3	7	35,700	670,000	45,000	30,000	75,000
Required interceptors				460,000	25,000		25,000
Independent industrial waste correction				360,000	55,000	5,000	60,000
Total				1,490,000	125,000	35,000	160,000
Comparative cost:							
Primary treatment all waste				1,300,000	110,000	25,000	135,000
Secondary treatment all waste				1,600,000	130,000	40,000	170,000
As suggested				1,490,000	125,000	35,000	160,000

DESCRIPTION

The Kentucky River, the largest stream lying wholly within the State of Kentucky, rises in the mountains near the Virginia border, flows in a general northwesterly direction across the State, and enters the Ohio River at Carrollton, Ky. It drains an area of approximately 6,940 square miles.

	Distance above mouth	Drainage area (square miles)
Major tributaries:		
Eagle Creek	11.0	500
Elkhorn Creek	52.2	440
Dix River	118.1	460
Red River	190.3	480
South Fork	254.8	736
Middle Fork	258.6	545
North Fork	258.6	1,305

	Populations			
	1910	1920	1930	1940
Larger cities:				
Lexington	35,099	41,534	45,736	49,304
Frankfort	10,465	9,805	11,626	11,492
Hazard	537	4,348	7,021	7,397
Richmond	5,340	5,622	6,495	7,335
Danville	5,420	5,099	6,729	6,734
Entire basin:				
Rural	293,650	317,234	341,608	385,916
Urban	63,792	75,802	88,604	96,053
Total	357,442	393,036	430,212	481,969

The upper half of the basin is mountainous and covered with second growth timber. Coal is mined extensively along the North Fork. Much of this mountain section is isolated and sparsely settled. Hazard is the only urban community in this area.

In contrast, the lower half of the basin includes a large part of the famous Bluegrass section of Kentucky, a very fertile agricultural area. The primary crops are tobacco, corn, and livestock. The distilling industry is important.

Water uses.—Although the main stream has been canalized for 260 miles by the construction of 14 locks and dams, the navigation facilities are relatively little used. The hydroelectric development on Dix River near its mouth is the only one of any size in the Kentucky Basin. The storage reservoir, known as Lake Herrington, provides Danville with a dependable source of water supply and is widely used for boating and fishing. The Kentucky River and many of its tributaries are used extensively for swimming, boating, and fishing.

Presentation of Field Data

Figure Ky–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure Ky–2 shows similar data and, in addition, the location of water-supply intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Of the 38 public water supplies in the basin, 19 are from underground sources and 19 are wholly or in part from surface sources. The 19 underground supplies serve only about 18,200 people, whereas the surface supplies serve 132,800 people. Underground water is generally available in very limited quantities and the chemical quality is usually poor although in the Bluegrass section there are a number of springs which yield moderately large

quantities of water of satisfactory chemical quality. Table Ky–2 shows data on the surface supplies of the basin. In addition to these supplies, Winchester, Ky., in the Licking Basin, maintains an emergency intake in the Kentucky River.

TABLE KY–2.—*Kentucky River Basin: Surface water supplies*

Municipality	Source	Mile [1]	Treatment [2]	Population served	Consumption (million gallons per day)
	Supplies below community sewer outfalls				
Frankfort	Kentucky River	67.5	FD	12,700	1.51
Versailles	Spring-well—Kentucky River [3]	89	FD	2,200	0.15
Lexington	Impounded—Kentucky River [3]	167	FD	66,500	5.60
Irvine	Kentucky River	218.6	CD	3,800	0.17
Pryse	do	226.8	CD	100	0.01
Beattyville	do	255	FD	600	0.02
Jackson	North Fork Kentucky River	305.5	FD	1,000	0.05
Hazard	do	361	FD	16,000	0.80
Stamping Ground	North Fork, Elkhorn Creek spring	86	FD	400	0.01
Danville	Dix River	149	FD	10,000	0.60
	Other surface supplies				
Sadieville	Eagle Creek	67.5	FD	400	0.01
Midway	Lees Branch-Well	87	FD	600	0.02
Manchester	Goose Creek	311	FD	1,000	0.03
Owenton	Impounded		FD	800	0.05
Eminence	do		FD	1,400	0.05
Lancaster	Impounded—Spring		FD	1,700	0.06
Stanford	do		FD	1,300	0.06
Berea	do		D	3,700	0.27
Richmond	Impounded		FD	8,600	0.80
Total:					
Below sewer outfalls				113,300	8.92
Other				19,500	1.35
Total, surface water supplies				132,800	10.27

[1] Miles above mouth of Kentucky River.
[2] F=Coagulated, settled, filtered; D=Chlorinated; C=Coagulated, settled.
[3] Emergency intakes in Kentucky River.

Sewerage.—Table Ky–3 shows the sewered population at each of the more important sources of pollution in the basin. Of the 105,300 people connected to sewers, about two-thirds are connected to sewage treatment plants. Ten secondary treatment plants serve 68,200 people, while the three primary treatment plants serve 1,200 people.

TABLE KY–3.—*Kentucky River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Stream	Miles above mouth of Kentucky River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Frankfort	Kentucky River	66	13,500	None	30,600	30,600
Tyrone	do	84			4,700	4,700
Irvine	do	218	3,300	None	3,300	3,300
Pryse	do	227	100	do	1,800	1,800
Jackson	North fork of Kentucky River.	305	1,300	do	1,300	1,300
Hazard	do	360	6,700	do	6,700	6,700
Whitesburg	do	404	1,700	do	1,700	1,700

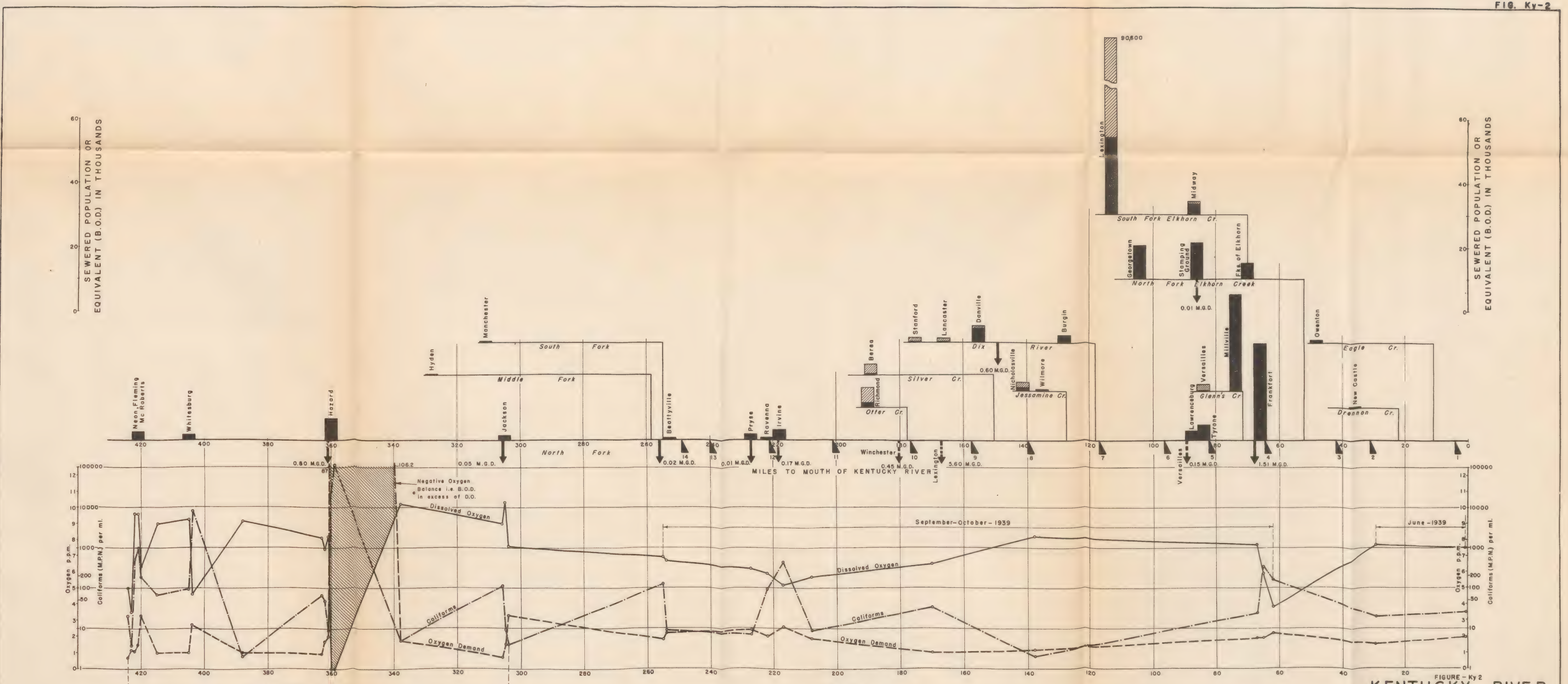


FIGURE - Ky 2
KENTUCKY RIVER
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE

TABLE KY-3.—*Kentucky River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*—Continued.

Municipality	Stream	Miles above mouth of Kentucky River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Owenton [1]	Stephens Creek	47	800	Primary	1,000	
Forks of Elkhorn	Elkhorn Creek	70			4,900	4,900
Stamping Ground	Locust Fork	86			11,500	11,500
Georgetown	North Elkhorn Creek	104	4,800	None	10,300	10,300
Midway [1]	Lees Branch-South Elkhorn Creek.	87	600	Secondary	4,200	3,700
Lexington	Town Branch of South Elkhorn Creek.	113	46,200	do	90,600	23,800
Millville	Glenns Creek	72		None	30,300	30,300
Versailles	do	84	2,100	Secondary	2,100	300
Lawrenceburg	Bailey's Run	87			2,900	2,900
Burgin	Dowling Branch	128			2,500	2,500
Danville [1]	Clarks Run	155	5,100	Secondary	5,300	1,000
Lancaster	Dix River tributary	166	1,300	do	1,300	200
Stanford [1]	St. Asaph Creek	175	1,200	do	1,500	200
Nicholasville [1]	Town branch of Jessamine Creek.	141	2,000	do	2,900	1,200
Berea [1]	Brush Fork of Silver Creek	189	3,300	do	3,400	500
Richmond	Dreaming Creek	190	5,700	do	6,300	1,400
McRoberts	Wrights Fork	423	2,000	None	2,000	2,000
7 smaller sources			3,600	Various	3,600	2,900
Total			105,300		236,700	150,400

[1] Treatment plant under construction at time of laboratory survey.

Industrial wastes.—Of the 23 industrial plants which are not connected to municipal treatment plants, 9 distilleries account for almost 90 percent of the total waste load. Table Ky-4 shows data on industrial waste-producing plants. All but 500 of the 32,900 population equivalent discharged to municipal treatment plants is at Lexington.

TABLE KY-4.—*Kentucky River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Canning	3	2	1	2	6,300
Distilling	9	0	9	9	86,200
Meat	6	1	5	2	1,100
Milk	3	1	2	1	1,000
Miscellaneous	2	0	2	1	3,900
Waste unconnected, municipal treatment	23	4	19	15	98,500
Waste connected to municipal treatment					32,900
Total industrial waste in basin					131,400

All of the distilleries have taken steps of one sort or another to reduce the pollutional significance of their wastes. The measures range from cattle-feeding, ponding, and broad irrigation to evaporation of the distillery slop. The fact that most of the companies operate only during the winter months when temperatures are low and stream flows usually high helps to reduce the seriousness of pollution from these sources.

Acid mine drainage causes problems of primarily local importance in the area drained by the North Fork. Records compiled while the mine-sealing program was active in Kentucky indicate 177 active, 62 marginal, and 416 abandoned coal mines in seven counties. One hundred and thirty-seven abandoned mines have been sealed. Mine sealing records indicate that water containing a total of 80 tons of mine acid daily flows into tributary streams in this mining area. Some progress has been made in reducing acid mine drainage through sealing 137 abandoned coal mines. The relatively high natural alkalinity of the natural run-off helps to reduce the damage by mine drainage.

Presentation of Laboratory Data

The laboratory observations for the Kentucky River Basin are summarized in table Ky–7. Selected data on the main stream and tributaries are in table Ky–5. Except for the observations at Gratz and Carrollton, all of the results were obtained by a mobile laboratory unit operating in the basin during September, October, and November 1939 and are representative of the low-flow conditions which prevailed in the basin at that time. The Gratz and Carrollton samples were collected over a period of several months.

Table Ky–5.—*Kentucky River Basin: Selected laboratory data*

River	Kentucky	Kentucky	Kentucky	Kentucky	Kentucky	Kentucky	Kentucky
Location	Above Beattyville	Below Beattyville	Below Irvine	Above Frankfort	Below Frankfort	At Gratz	Mouth, Carrollton
River miles above mouth of Kentucky.	255	254.3	216.5	67	62	29	0.2
Period, 1939	Sept. 29 and Oct. 3	Sept. 29	Oct. 3	Sept. 27 and Oct. 5	Sept. 27 and Oct. 5	June 1–15	Aug. 4–24
Number of samples	2	1	1	2	2	3	4
Flow in cubic feet per second:							
Sampling days	148	148	206	443	443	2,500	2,875
Minimum month	9	9	15	91	91		
Water temperature, ° C	22.5	24.5	21.5	22.0	22.0	24.0	25.9
Coliforms, per milliliter	125	9	2,400	23	167	19	25
Dissolved oxygen, parts per million	6.9	6.7	5.8	7.7	3.8	7.7	6.3
Biochemical oxygen demand, 5-day, parts per million	1.8	2.2	1.6	1.9	2.2	1.5	1.6

River	North Fork	North Fork	Walnut, Meadow Branch	Clark	Town Branch	North Fork, Elkhorn	North Fork, Elkhorn
Location	Above Hazard	Below Hazard	Below Berea	Below Danvile	Below Lexington	Above Georgetown	Below Georgetown
River miles above—							
Confluence with Kentucky	105	104	42	36	61	40	38
Mouth of Kentucky	360.5	359.5	188.5	154	113	92	90
Period, 1939	October	Oct. 26	Sept. 29–Oct. 10	Sept. 28–Oct. 9	Sept. 25–Oct. 10	Sept. 26 and Oct. 5	Oct. 13
Number of samples	3	1	3	3	3	2	1
Flow in cubic feet per second:							
Sampling days	3.0	4.9					
Water temperature, ° C	18.7	23.5	20	20.9	21.8	18.5	14.0
Coliforms, per milliliter	110	110,000	36,800	60,000	4,500	25	24,000
Dissolved oxygen, parts per million	9.1	0	0.6	0.4	4.3	7.2	0
Biochemical oxygen demand, 5-day, parts per million	2.6	106.2	85.2	24.0	11.4	1.7	28.5

Fig. Ky-3

KENTUCKY-LICKING-SALT BASINS

COLIFORM RESULTS

Fig. Ky-3

(Face p. 676) No. 1 GPO-43 O-98035

Fig. Ky-4

Fig. Ky-4

KENTUCKY - LICKING - SALT BASINS

DISSOLVED OXYGEN RESULTS

(Face p. 676) No. 2

GPO-43 O-80035

Fig. Ky-5

KENTUCKY-LICKING-SALT BASINS

BIOCHEMICAL OXYGEN DEMAND

(Face p. 676) No. 8

GPO-43 O-90035

Fig. Ky-5

Figures Ky–3, Ky–4, and Ky–5 show by means of symbols the results of the coliform, dissolved oxygen, and oxygen demand determinations at the various sampling points in the basin. In each case the results shown for Gratz and Carrollton represent the most unfavorable monthly averages of the observations at these points made over the several-month sampling period. At all other points the results represent the averages of from one to three samples collected over short periods of less than 1 month by the mobile laboratory unit. The full effects of distillery wastes on the streams in this basin were not observed at the time of this survey as not all of the plants were in operation.

The results of these laboratory observations indicate that except for two stretches below Irvine and Frankfort the main Kentucky River is not seriously polluted. Gross pollution, however, seems to be the rule below most of the communities investigated along the tributaries. The coliform observations, in general, corroborate the dissolved oxygen and oxygen demand results except on the North Fork above Hazard where the coliforms tend to show the worst conditions. A tendency toward fairly rapid recovery below the zones of pollution is indicated by well-marked coliform and oxygen demand reductions and by dissolved oxygen recoveries.

Acid mine wastes were encountered in the area above Hazard. Irishman Creek, Millstone Creek, Thornton Creek, and Yellow Creek were found to be acid, with pH values ranging from 2.8 to 4.9 and phenolphthalein acidities from 18 to over 900 parts per million.

Biological summary.—The flora and fauna of the Kentucky River are low; less than 2,000 parts per million except when a "bloom" of Pandorina appeared at Carrollton. The low plankton volume is indication of a clean stream. Good fishing is reported from Carrollton to Gratz.

Hydrometric Data

Sixteen stream gaging stations have been operated in the basin at various times, only four of which are currently in operation. These four are all on the Kentucky River. All of the tributary streams are subject to extremely low flows, although discharge records are too short to indicate probable low flows with any degree of certainty. Table Ky–6 shows monthly mean flows during some of the low-flow years.

TABLE KY-6.—*Kentucky River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Kentucky	Kentucky
Location	At Frankfort [1]	Near Winchester
River miles above mouth of Kentucky River	65	176
Drainage area (square miles)	5,400	3,990
Period of record	1925–40	1909–40
Year	1930	1930
June cubic feet per second	226	234
July do	121	48.8
August do	149	34.2
September do	[2] 91.3	[2] 15.8
Year	1936	1932
June cubic feet per second	544	1,060
July do	524	3,690
August do	350	1,490
September do	576	55.2
Year	1929	1936
June cubic feet per second	2,460	116
July do	3,890	138
August do	478	80.3
September do	1,040	246

[1] The accuracy of low-flow records at this station is poor.
[2] Minimum month.

Low-flow regulation.—A number of possible reservoir sites on the Kentucky River and its tributaries have been surveyed by the United States Engineer Department. These studies indicate that the Jessamine Reservoir on the main stream and the Booneville Reservoir on the South Fork are the most nearly satisfactory for flood control and allied development. Low-flow regulation by these reservoirs would benefit the lower 12 miles of the South Fork and the entire Kentucky River.

Such low-flow regulation would have little tangible value since it would not eliminate the need for primary treatment at the communities along the streams affected and primary treatment is considered adequate under present uncontrolled flow conditions.

DISCUSSION

The rapidity with which the streams of the Kentucky Basin recover from the effects of pollution and the lack of intensive urban and industrial development make the pollution problems of the Kentucky Basin largely a series of local problems. Most of the worst conditions have been dealt with.

Of the cities without treatment plants, Frankfort is the largest. The Kentucky River at this point has a drainage area of 5,400 square miles, and flows of less than 100 cubic feet per second have been recorded. No public water supplies are taken from the Kentucky below Frankfort, and the lower part of the river, at some distance below Frankfort, is regarded as a good fishing stream. Primary treatment of the sewage and industrial wastes (except distillery wastes) should be sufficient. More complete treatment of the distillery waste is needed. This can be effected by evaporation of the slop plus lesser improvement at small plants.

At Irvine and Ravenna the public water supply is taken from the Kentucky River below the point of entrance of Ravenna's sewage. The water is not filtered. Primary treatment of the sewage from these places should be sufficient to maintain an excellent oxygen balance in the stream. Changes in the water supply intake location or improved methods of treatment, or both, will be necessary to protect the water supply.

At Hazard, Georgetown, Whitesburg, McRoberts, and Jackson complete treatment appears justified because of the extremely low flows in the receiving streams.

The cost of these remedial measures and of other necessary pollution abatement measures is summarized in table Ky–1.

TABLE KY-7.—*Kentucky River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature, ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Wright Fork, above water plant, McRoberts, Ky.	KyNfBW 424	Oct. 18, 1939		13.5	5.0	47.4	.8	4	7.8	3	527	
Do	do	Oct. 31, 1939		12.5	5.1	47.4	.7	36	7.8	8	540	
Wright Fork, at water plant, McRoberts, Ky.	KyNfBW 423	Oct. 25, 1939		15.0	3.5	34.5	1.2	4	8.3	4	529	
Wright Fork, above Shea Fork, McRoberts, Ky.	KyNfBW 422	Oct. 18, 1939		11.0	10.1	91.5	1.3	240	8.4	4	441	
Do	do	Oct. 25, 1939		14.5	9.0	87.4	.4	1,100	8.4	3	465	260
Do	do	Oct. 31, 1939		10.0	9.7	85.8	1.6	240	8.3	8	453	
Wright Fork, upper edge Fleming, Ky.	KyNfBW 421	Oct. 18, 1939		9.5	10.5	91.5	1.8	240	8.4	5	484	
Do	do	Oct. 25, 1939		15.0	8.9	87.4	1.4	2,400	8.4	5	484	236
Do	do	Oct. 31, 1939		9.5	9.5	82.7	1.4	430	8.2	5	490	
Yonts Fork, above Neon, Ky	KyNfBY 420	Oct. 18, 1939		8.0	10.4	87.6	.5	240	7.2	4	57	
Do	do	Oct. 25, 1939		14.5	8.4	82.2	.8	460	7.4	3	73	597
Boone Fork, above Potters Fork, Neon, Ky.	KyNfB 419.8	Oct. 18, 1939		12.0	8.3	76.7	3.0	240	7.9	14	269	
Do	do	Oct. 25, 1939		13.5	4.2	40.4	3.5	150	7.8	7	379	
Potters Fork, mouth, Neon Junction, Ky.	KyNfBP 419	Oct. 18, 1939		9.0	10.7	92.3	1.3	110	8.2	9	361	
Do	do	Oct. 25, 1939		14.0	7.1	68.5	1.2	460	8.0	3	359	
North Fork Kentucky River, above Boone Fork, Kona, Ky.	KyNf 416	Oct. 19, 1939		10.0	11.0	96.6	.5	46	7.9	4	207	
Do	do	Oct. 26, 1939		16.5	8.1	82.5	1.0	240	7.8	7	196	354
North Fork Kentucky River, above Thornton Creek, Thornton, Ky.	KyNf 415	Oct. 19, 1939		10.5	10.1	89.9	.9	46	7.9	6	256	
Do	do	Oct. 26, 1939		16.5	7.8	79.6	1.1	93	7.6	10	231	328
Thornton Creek, mouth, Thornton, Ky.	KyNfT 414	Oct. 19, 1939		8.5	11.5	98.3	.9	(1)	3.3	5	0	
Do	do	Oct. 26, 1939		16.0	8.1	81.3	3.9	(1)	3.3	6	0	
North Fork Kentucky River, upper edge Whitesburg, Ky.	KyNf 405	Oct. 19, 1939	(1)	10.0	9.8	86.8	1.0	9	7.9	5	186	
Do	do	Oct. 26, 1939	(1)	16.0	6.3	63.0	1.2	240	7.8	4	196	349
Do	do	Nov. 2, 1939	(1)	6.0	11.5	92.1	1.0	43	7.8	6	152	
North Fork Kentucky River, lower edge Whitesburg, Ky.	KyNf 404	Oct. 19, 1939	(1)	11.0	5.1	45.8	1.4	460	7.7	4	191	
Do	do	Oct. 26, 1939	(1)	16.5	0	0	5.8	24,000	7.5	7	203	316
Do	do	Nov. 2, 1939	(1)	6.5	8.8	71.4	.9	460	7.7	5	166	

Sandlick Creek, 100 yards above mouth.	KyNfS 402	Oct. 20, 1939		17.5	11.1	115.0	.6	46	6.8	3	13	
Do	do	Oct. 26, 1939		19.0	8.4	89.4	.8	43	6.8	5	20	496
Rockhouse Creek, at mouth	KyNfR 390	Oct. 20, 1939		14.5	10.1	98.4	.8	24	7.5	5	63	
Do	do	Oct. 27, 1939		20.0	8.1	88.1	1.6	240	7.4	60	69	
Do	do	Nov. 2, 1939		4.5	11.6	89.7	.8	43	7.4	7	69	
North Fork Kentucky River, above Blackey, Ky.	KyNf 388	Oct. 20, 1939	4	15.0	10.4	102.3	1.1	2	7.9	5	123	
Do	do	Oct. 27, 1939	4	20.0	7.7	84.3	.8	1	7.7	20	126	
Line Fork Creek, mouth, Ulvah, Ky.	KyNfL 380.5	Oct. 20, 1939	4	11.5	8.8	80.7	1.0	9	7.3	4	50	
Do	do	Oct. 27, 1939	4	19.5	5.8	63.1	2.3	46	7.0	18	52	
Big Leatherwood Creek, at mouth, Cornettsville, Ky.	KyNfL 379	Oct. 20, 1939		10.5	6.6	58.9	1.8	9	7.3	8	75	
Do	do	Oct. 27, 1939		18.0	3.9	40.9	4.2	240	7.1	145	87	
Do	do	Nov. 2, 1939		5.0	8.9	69.2	1.9	23	7.3	8	67	115
Irishman Creek, 4½ miles above Sassafras, Ky.	KyNfCI 384	Oct. 31, 1939		8.5	10.7	91.2		240	4.9	4	15	
Do	do	Nov. 3, 1939		4.0	12.1	92.1		4	6.1	8	11	
Do	do	Nov. 17, 1939		4.0	11.8	90.2	Lost	4	4.9	6		
Yellow Creek, mouth, Sassafras, Ky.	KyNfCY 380	Oct. 20, 1939		21.5	5.5	61.8	.7	(1)	2.8	9		
Do	do	Oct. 27, 1939		22.0	5.1	57.3	6.8	(1)	2.8	43		
Do	do	Oct. 31, 1939		8.5				(1)	2.9	18		
Do	do	Nov. 17, 1939		3.5	14.2	106.5	Lost	(1)	2.9	20		676
Carr Fork, mouth, Jeff, Ky.	KyNfC 368	Oct. 20, 1939		10.5	10.1	90.2	.7	4	6.2	4	14	
Do	do	Oct. 27, 1939		18.0	6.2	65.2	1.4	9	6.5	4	17	
North Fork Kentucky River, above spray, Lothair, Ky.	KyNf 363	Oct. 25, 1939		25.5	7.5	89.9	.7	93	7.8	14	96	
Do	do	Oct. 31, 1939		15.5	8.7	86.9	1.2	43	7.6	27	75	
North Fork Kentucky River, at water plant, Lothair, Ky	KyNf 362	Oct. 26, 1939		30.0	7.0	91.1	1.9	4	8.1	14	95	197
Do	do	Oct. 31, 1939		20.0	7.8	85.0	1.5	93	7.6	20	74	
North Fork Kentucky River, in pool above water intake, Hazard, Ky.	KyNf 361	Oct. 23, 1939		8.0	5.6	47.5	6.8	430	7.8	35	204	
Do	do	Oct. 27, 1939	9	21.0	8.0	89.2	2.1	9	7.6	15	83	
North Fork Kentucky River, above at waterworks, Hazard, Ky.	KyNf 360.5	Oct. 16, 1939	3	19.0	9.2	98.7	2.3	46	7.7	20	83	
Do	do	Oct. 23, 1939	3	19.0	9.7	103.6	3.3	240	7.6	15	83	
Do	do	Oct. 25, 1939	3	18.0	8.3	87.0	2.2	43	7.6	15	84	195
North Fork Kentucky River, midtown, Hazard, Ky.	KyNf 360.2	Oct. 16, 1939	3	9.5	7.9	68.8	1.6	150	7.4	17	86	
Do	do	Oct. 23, 1939	3	10.0	5.0	44.4	2.9	93	7.4	10	128	
North Fork Kentucky River, below last sewage, Hazard, Ky.	KyNf 360	Oct. 23, 1939	3	10.0	0	0	87.0	24,000	6.9	80	246	
North Fork Kentucky River, 100 yards below last sewage, Hazard, Ky.	KyNf 359.8	Oct. 16, 1939	4	8.5	3.3	28.2	8.8	4,600	7.3	13	97	
North Fork Kentucky River, 712 feet below last sewage, Hazard, Ky.	KyNf 359.5	Oct. 26, 1939	5	23.5	0	0	106	110,000	7.4	110	237	296

[1] Less than 1.

TABLE KY-7.—*Kentucky River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature, ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Lott Creek, mouth, 3 miles below Hazard, Ky.	KyNfLc 358	Oct. 23, 1939	7	10.0	9.2	81.1	2.1	240	7.9	5	202	245
Do	do	Oct. 27, 1939	7	18.5	7.4	78.2	3.5	1,100	7.2	173	60	----------
Do	do	Nov. 2, 1939	7	6.5	12.4	100.7	2.0	460	7.4	8	78	----------
North Fork Kentucky River, bridge at Chavies, Ky.	KyNf 338	Oct. 17, 1939	5	17.0	11.0	112.5	1.9	1	7.6	3	82	----------
Do	do	Oct. 24, 1939	5	18.0	9.5	99.3	1.5	9	7.4	14	90	180
Troublesome Creek, mouth, Haddix, Ky.	KyNfT 316	Oct. 17, 1939	----------	12.0	10.0	92.3	1.0	4	7.2	15	45	----------
Do	do	Oct. 24, 1939	----------	11.5	8.7	79.3	.8	4	7.2	14	46	----------
Quicksand Creek, mouth, Quicksand, Ky.	KyNfQ 310	Oct. 17, 1939	----------	11.0	9.8	88.9	1.9	240	7.2	12	52	----------
Do	do	Oct. 24, 1939	----------	11.0	8.8	79.3	1.9	23	7.1	15	53	116
Do	do	Nov. 3, 1939	----------	9.5	11.6	101.4	----------	4	7.2	18	201	----------
North Fork, Kentucky River, 1 mile above Jackson, Ky.	KyNf 306	Oct. 24, 1939	4	12.5	9.0	84.1	.7	110	7.4	18	79	145
North Fork, Kentucky, River upper edge Jackson, Ky.	KyNf 305.5	Oct. 17, 1939	15	11.5	10.3	94.3	1.5	9	7.5	16	71	----------
North Fork, Kentucky River, ¼ mile below last sewage, Jackson, Ky.	KyNf 304.7	Oct. 17, 1939	15	11.5	8.0	72.7	3.2	4	7.6	35	129	----------
Do	do	Oct. 24, 1939	5	13.5	7.2	68.8	3.3	4	7.6	40	134	183
Middle Fork, Kentucky River, below Hyden, Ky.	KyMf 328	Oct. 16, 1939	----------	10.5	9.2	81.8	.9	7	7.3	11	37	----------
Do	do	Oct. 23, 1939	----------	14.0	8.5	82.0	.9	24	7.1	9	32	----------
Kentucky River, upper edge, Beattyville, Ky.	Ky 255	Sept. 29, 1939	148	25.0	7.5	89.0	2.1	240	7.3	----------	61	----------
Do	do	Oct. 3, 1939	148	20.0	6.4	69.7	1.5	9	7.2	13	63	----------
Red Bird Creek, bridge, Big Creek, Ky.	KySfR	Oct. 16, 1939	----------	11.0	8.8	79.2	1.6	(1)	7.3	28	47	----------
Do	do	Oct. 23, 1939	----------	14.5	8.0	77.9	1.7	4	7.3	27	45	----------
Goose Creek, ¼ mile above Manchester, Ky.	KySfG 311.5	Oct. 16, 1939	----------	13.0	6.7	63.0	1.7	9	7.2	12	64	----------
Do	do	Oct. 23, 1939	----------	15.0	5.2	50.9	2.2	110	7.1	12	56	----------
Do	do	Nov. 3, 1939	----------	10.5	6.0	53.1	----------	43	7.0	7	187	----------
Goose Creek, 50 yards below last sewer, Manchester.	KySfG 310.8	Nov. 3, 1939	----------	8.5	8.3	71.1	----------	240	7.2	10	193	----------
Goose Creek, 100 yards below last sewer, Manchester.	KySfG 310.6	Oct. 16, 1939	----------	9.0	4.5	39.0	1.9	93	7.2	5	76	----------
Do	do	Oct. 23, 1939	----------	11.5	4.9	44.4	5.7	15	7.3	7	79	----------

Kentucky River, 300 feet below last sewer, Beattyville.	Ky 254.7	Oct. 12, 1939	148	21.5	7.0	78.5	1.6	23	7.3	16	57	126
Kentucky River, ½ mile below last sewer, Beattyville.	Ky 254.3	Sept. 29, 1939	148	24.5	6.7	79.4	2.2	9	7.2		59	
Kentucky River, 1 mile below Beattyville, Ky.	Ky 253.8	Oct. 3, 1939	148	22.5	6.1	69.4	1.0	15	7.2	15	61	118
Kentucky River, ¾ mile above Pryse, Ky.	Ky 227	Sept. 29, 1939		24.5	7.7	90.8	2.4	9	7.2		43	
Do	do	Oct. 3, 1939		21.5	4.7	52.4	2.4	4	7.0	11	52	113
Kentucky River above Cow Creek, above Ravenna, Ky.	Ky 222	Sept. 29, 1939		24.5	7.4	87.6	3.0	2	7.1		51	
Do	do	Oct. 3, 1939		20.5	5.2	57.8	2.2	240	7.0	14	56	120
Do	do	Oct. 12, 1939		21.0	5.2	57.5	1.0	43	7.1	11	51	
Kentucky River, 50 yards below last sewage, Irvine, Ky.	Ky 217	Oct. 12, 1939	206	19.5	5.2	56.2	2.6	430	7.2	15	65	132
Kentucky River, 100 yards below new bridge, Irvine, Ky.	Ky 216.5	Oct. 3, 1939	206	21.5	5.8	65.3	1.6	2,400	7.2	10	59	110
Kentucky River, 10 miles below Irvine, Ky.	Ky 208	Sept. 29, 1939		25.0	5.7	68.1	1.9	9	7.2		54	
Dreaming Creek, ⅛ mile below Richmond, Ky.	KyOD 190	Sept. 25, 1939		18.5	6.6	69.8	6.8	150	7.6		145	
Dreaming Creek, 1 mile below Richmond, Ky.	KyOD 189.5	Oct. 2, 1939		9.5	6.3	54.6	5.0	240	7.5	5	154	207
Do	do	Oct. 10, 1939		18.5	3.6	38.3	6.7	93	7.5	25	163	197
Kentucky River Bridge, at Clay Ferry, Ky.	Ky 170	Sept. 25, 1939		22.5	5.8	66.3	1.1	93	7.4		52	
Do	do	Oct. 2, 1939	206	18.5	7.1	74.9	0	4	7.4	12	60	95
Do	do	Oct. 10, 1939		21.0	6.7	74.5	1.7	(1)	7.5	9	61	104
Silver Creek, below Berea, Ky	KySi 189	Oct. 10, 1939		20.0	4.6	49.8	3.8	240	7.1	10	65	151
Walnut Meadow Branch, ¼ mile below outlet of Berea College.	KyPW 188.5	Sept. 29, 1939		22.5	0	0	151	110,000	7.1		272	
Do	do	Oct. 2, 1939		18.5	1.7	18.1	93	360	7.3	143	202	158
Do	do	Oct. 10, 1939		19.0	0	0	11.5	150	7.6	67	252	190
Kentucky River Bridge, on Route No. 27, Camp Nelson, Ky.	Ky 138	Sept. 28, 1939		23.0	7.6	88.0	1.8	4	7.7	12	86	
Do	do	Oct. 4, 1939		19.5	8.5	91.7	.6	1	7.7	25	84	119
Do	do	Oct. 9, 1939		22.0	8.6	97.2	1.3	(1)	7.6	15	84	128
Town Branch, ½ mile below Nicholasville, Ky.	KyJT 141	Sept. 25, 1939		18.5	1.8	18.8	7.3	91	7.7		333	
Do	do	Oct. 4, 1939		12.5	2.0	18.3	7.9	210	7.6	15	343	293
Do	do	Oct. 9, 1939		18.0	.2	2.1	10.4	2,400	7.6	25	378	282
Town Branch, 3 miles below Nicholasville, Ky.	KyJT 138	Sept. 25, 1939		17.5	6.1	63.3	2.2	43	7.8		192	
Do	do	Oct. 4, 1939		12.5	5.8	53.9	1.7	43	7.6	8	195	226
Do	do	Oct. 9, 1939		18.5	2.6	28.1	1.9	43	7.5	8	180	212
Jessamine Creek, 1 mile below Wilmore, Ky.	KyJ 134	Sept. 28, 1939		18.5	5.9	62.6	2.5	75	7.8	10	174	
Do	do	Oct. 4, 1939		13.0	9.6	90.3	1.5	15	7.9	7	160	174
Do	do	Oct. 9, 1939		18.0	7.6	79.2	.8	4	7.8	6	170	192
St. Asaph Creek, ½ mile below last sewer, Stanford, Ky.	KyDLS 174	Sept. 28, 1939		22.0	2.0	22.1	9.0	230	7.9	44	374	

[1] Less than 1°

TABLE KY-7.—*Kentucky River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature, ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
St. Asaph Creek, ½ mile below disposal plant, Stanford, Ky.	KyDLS 174	Oct. 4, 1939		13.0	4.0	37.5	3.6	460	7.6	15	230	232
St. Asaph Creek, 1 mile below Stanford, Ky.	KyDLS 173	Oct. 9, 1939		17.5	1.4	15.0	4.8	23	7.6	13	359	281
Town Branch Creek, below Lancaster, Ky.	KyDT 162	Sept. 28, 1939		19.0	5.1	54.9	3.2	240	7.5	7	178	
Town Branch, ½ mile below Lancaster, Ky.	KyDT 161.5	Oct. 4, 1939		13.5	6.7	64.2	1.4	43	7.6	6	167	241
Town Branch, 1 mile below Lancaster, Ky.	KyDT 161	Oct. 9, 1939		17.5	4.0	42.0	6.2	1,100	7.5	10	199	248
Clark Run, 1 mile below Danville, Ky.	KyDCr 154	Sept. 28, 1939		22.5	0	0	30.8	24,000	7.6	28	318	
Do	do	Oct. 4, 1939		17.5	0	0	26.1	110,000	7.6	23	80	209
Do	do	Oct. 9, 1939		22.0	1.1	12.8	15.0	46,000	7.6	15	256	225
Town Branch, 1 mile below Danville, Ky.	KyDT 154	Sept. 28, 1939		24.5	3.0	35.6	34.2	2,400	7.7	121	374	
Do	do	Oct. 4, 1939		20.0	4.4	48.2	9.2	2,400	7.7	68	307	234
Do	do	Oct. 9, 1939		24.0	1.5	17.4	17.8	11,000	7.6	270	335	237
Kentucky River, 1 mile above Frankfort, Ky.	Ky 67	Sept. 27, 1939		24.0	8.7	102.5	2.0	43	8.1	15	86	
Do	do	Oct. 5, 1939		20.0	6.7	73.4	1.7	4	7.6	23	91	127
Benson Creek, 1 mile above Frankfort, Ky.	KyB 68	Sept. 27, 1939	331	23.0	7.8	90.0	3.2	9	7.9	34	92	
Do	do	Oct. 5, 1939	600	19.0	5.9	63.0	2.2	240	7.5	26	94	131
Do	do	Oct. 13, 1939	396	15.0	6.8	66.5	4.3	93	7.8	64	104	152
Kentucky River, Lock No. 4, Frankfort, Ky.	Ky 65	Sept. 27, 1939	331	23.5	6.6	76.3	2.4	240	7.8	13	87	
Do	do	Oct. 5, 1939	600	20.0	5.2	56.9	1.8	460	7.6	19	89	130
Penitentiary Run, at Kentucky River, below Frankfort, Ky.	KyP 65	Sept. 27, 1939	331	21.5	0	0	107.4	24,000	6.9	360	238	
Do	do	Oct. 5, 1939	600	20.0	0	0	183.0	240,000	7.0	230	246	259
Do	do	Oct. 13, 1939	396	16.5	0	0	389.0	240,000	6.7	185	311	406
Kentucky River, 4 miles below Frankfort, Ky.	Ky 62	Sept. 27, 1939		23.5	3.4	39.4	2.6	93	7.3	18	86	
Do	do	Oct. 5, 1939		20.5	4.2	46.5	1.9	240	7.4	25	89	128
North Elkhorn Creek, corporation line, above Georgetown, Ky.	KyElNf 92	Sept. 26, 1939		19.0	5.5	58.8	.3	4	7.8	11	179	
Do	do	Oct. 5, 1939		18.0	9.0	93.8	2.8	46	8.0	14	192	206
North Elkhorn Creek, 100 yards below last sewage outlet, Georgetown, Ky.	KyElNf 90	Oct. 13, 1939		14.0	0	0	28.5	24,000	7.3	47	268	268

North Elkhorn Creek, 1 mile below Georgetown, Ky.	KyElNf 89	Sept. 26, 1939		19.5	1.8	19.8	7.1	73	7.6	13	250	
Do	do	Oct. 5, 1939		19.0	4.7	50.5	26.9	23	7.7	47	254	239
Locust Creek, ½ mile below Stamping Ground.	KyElNfL 75	Sept. 26, 1939		18.0	4.7	49.7	2.6	93	7.6	28	141	
Do	do	Oct. 5, 1939		20.5	9.7	107.2	2.3	23	8.0	12	140	184
Town Branch Creek, 1 mile below Lexington, Ky.	KyElSfTb 113	Sept. 25, 1939		24.5	2.0	23.3	20.9	4,300	7.4		147	209
Do	do	Oct. 2, 1939		18.4	6.6	70.2	7.9	4,600	7.6	10	147	
Do	do	Oct. 10, 1939		22.5	4.2	48.2	5.5	4,600	7.6	11	205	188
South Fork, Elkhorn Creek, ¼ mile below Narcotic Farm disposal, Lexington, Ky.	KyElSf 95	Sept. 26, 1939		29.5	1.9	24.8	3.6	430	7.2	10	98	174
Do	do	Oct. 2, 1939		24.5	4.0	47.0	2.3	460	7.0	8	70	
Do	do	Oct. 10, 1939		27.5	1.9	24.0	3.4	240	7.2	7	98	152
Do	do	Oct. 13, 1939		20.5	4.0	43.6	11.4	11,000	7.5	28	157	181
Town Branch Creek, 1 mile below Versailles, Ky.	KyElSfTb 95	Sept. 28, 1939		24.0	4.8	56.6	5.0	460	7.6	162	180	
Do	do	Oct. 5, 1939		14.5	6.3	61.1	2.4	93	7.6	22	149	213
Lee Branch, 200 feet below disposal plant, Midway, Ky.	KyElSfL 82	Sept. 26, 1939		20.5	5.7	62.4	3.6	240	7.6	9	176	
Do	do	Oct. 5, 1939		20.5	9.3	102.6	3.7	23	8.0	7	189	
South Fork Elkhorn Creek Bridge at Fork Elkhorn Creek.	KyElSf 67	Sept. 26, 1939		20.5	10.3	113.1	3.5	15	8.4	14	205	
Do	do	Oct. 5, 1939		19.0	9.1	97.4	1.5	8	8.2	16	213	199
Kentucky River, Gratz, Ky	Ky 29	Mar. 2, 1939		6.0	12.3	99.0	1.7	0				
Do	do	Mar. 9, 1939		11.0	10.7	96.8	1.5	43				
Do	do	Mar. 17, 1939		8.5	11.4	97.4	.7	23	8.0	200	57	
Do	do	Mar. 21, 1939		9.0	11.8	101.9	1.2	9	8.0	160	57	
Do	do	Mar. 29, 1939		11.0	11.4	103.0	1.8	110	7.9	140	71	
Do	do	Apr. 6, 1939		9.5	11.4	99.1	1.7	24	7.5	450	67	
Do	do	Apr. 14, 1939		9.5	12.2	106.0	1.6	43	7.7	110	55	
Do	do	Apr. 24, 1939		14.0	10.6	102.3	.7	20	7.5	95	74	
Do	do	May 2, 1939		15.5	9.7	96.8	1.8	23	7.7	85	66	
Do	do	May 10, 1939		18.0	9.0	94.3	1.1	4	8.0	45	77	
Do	do	May 18, 1939		19.5	8.9	96.1	1.3	5	8.0	18	80	
Do	do	May 26, 1939		22.5	8.7	99.1	2.1	5	7.8	20	80	
Do	do	June 1, 1939		23.5	7.7	89.2	1.1	11	7.7	25	77	
Do	do	June 9, 1939		25.0	7.2	86.3	1.9	24	7.8	102	77	
Do	do	June 15, 1939		23.5	8.1	94.4	1.5	23	7.8	79	71	
Do	do	Feb. 5, 1940		2.0	13.3	96.4	1.1	(1)	7.8	15		
Do	do	Feb. 13, 1940		3.5	13.7	103.0	1.8	21	7.5		81	
Do	do	Feb. 20, 1940		5.0	12.6	98.5	2.2	9	7.5	320	67	
Do	do	Feb. 27, 1940		5.5	13.0	102.8	1.2	9	7.5	87	69	
Do	do	Mar. 4, 1940		7.0	10.6	86.7	2.7	43	7.4	650	62	
Do	do	Mar. 8, 1940		6.0	11.9	95.4	1.4	15	7.5	350	48	
Kentucky River, at mouth, Carrollton, Ky.	Ky 0.2	Mar. 9, 1939	62,700	9.5	10.9	94.8	1.4	93				
Do	do	Mar. 17, 1939	15,400	8.5	10.8	92.4	.6	15	7.8	280	63	
Do	do	Mar. 23, 1939	6,310	10.0	11.4	100.7	1.2	23	8.1	150	67	
Do	do	Mar. 31, 1939	22,600	9.0	10.8	93.4	3.2	43	7.8	750	69	

[1] Less than 1.

TABLE KY–7.—*Kentucky River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Kentucky, River, at mouth, Carrollton, Ky.	do	Apr. 6, 1939	22,800	9.5	11.2	98.1	1.7	43	7.4	450	74	
Do	do	Apr. 14, 1939	24,300	9.5	12.0	104.3	1.6	15	7.7	72	51	
Do	do	Apr. 24, 1939	9,630	14.0	9.8	95.0	1.5	43	7.6	160	86	
Do	do	May 2, 1939	6,970	16.0	9.7	97.7	1.4	7	7.8	62	75	
Do	do	May 10, 1939	3,800	19.0			2.1	3	8.0	47	84	
Do	do	May 18, 1939	1,870	20.0	8.2	89.1	1.6	1	7.9	20	89	
Do	do	May 26, 1939	3,100	23.0	9.3	107.1	6.7	[1]	7.9	20	90	
Do	do	June 1, 1939	2,470	24.0	7.4	87.2	2.6	2	7.8	25	86	
Do	do	June 9, 1939	3,170	26.0	7.3	88.6	2.6	1	7.7	57	86	
Do	do	June 15, 1939	2,790	25.0	7.6	90.5	1.7	9	8.0	65	68	
Do	do	June 23, 1939	10,900	25.0	7.9	94.5	1.7	93	7.6	600	78	
Do	do	June 29, 1939	3,170	26.0	7.2	87.3	1.4	46				
Do	do	July 7, 1939	62,000	27.0	6.7	83.0	3.4	460	7.5	540	72	
Do	do	July 13, 1939	4,950	26.0	7.8	94.6	2.9	93	7.2	800	46	
Do	do	July 21, 1939	2,410	26.0	7.2	87.2	1.2	23	7.3	220	64	
Do	do	July 27, 1939	6,400	26.0	6.8	83.0	2.9	240	7.3	700	66	
Do	do	Aug. 4, 1939	6,150	25.0	6.4	76.1	1.5	23	7.5	170	80	
Do	do	Aug. 10, 1939	1,470	26.0	6.5	78.8	1.4	43	7.5	220	82	
Do	do	Aug. 18, 1939	2,310	26.5	6.0	73.3	1.9	23	7.3	340	77	
Do	do	Aug. 24, 1939	1,630	26.0	6.4	77.9	1.7	9	7.8	72	91	
Do	do	Sept. 1, 1939	1,610	25.5	7.0	84.7	1.2	5	7.5	15	88	
Do	do	Sept. 7, 1939	950	26.0	8.1	98.5	1.4	2	7.9	15	86	
Do	do	Sept. 15, 1939	950	27.0	8.9	110.7	1.6	2	8.1	7	95	
Do	do	Sept. 21, 1939	267	23.5	7.2	83.4	1.4	9	7.7	20	94	
Do	do	Sept. 29, 1939	1,370	23.5	5.8	67.8	.7	[1]	7.5	10	103	
Do	do	Oct. 5, 1939	760	20.5	5.8	64.2	1.1	11	7.5	12	96	
Do	do	Oct. 13, 1939	502	20.0	5.4	59.0	1.0	2	7.5	9	104	
Do	do	Oct. 19, 1939		17.5	6.7	69.5	1.2	[1]	7.5	6	104	
Do	do	Oct. 27, 1939	586	18.5	7.2	75.8	.9	4			102	
Do	do	Nov. 2, 1939	950	13.0	7.6	72.0	1.2	9	7.5		101	
Do	do	Nov. 10, 1939	592	12.0	8.4	77.6	.6	9	7.5			
Do	do	Nov. 16, 1939	586	9.0	9.9	85.4	1.0	2	7.4		86	
Do	do	Nov. 24, 1939	760	9.0	9.1	78.7	3.4	1		15	96	
Do	do	Nov. 30, 1939	760	8.0	9.4	78.9	.8	2				
Do	do	Dec. 8, 1939	586	7.0	10.2	83.7	1.0	[1]			99	
Do	do	Dec. 14, 1939	586	6.0	10.2	81.7	3.2	24	7.4	10	96	
Do	do	Dec. 22, 1939	420		10.9		.8	36	7.5	15	104	
Do	do	Dec. 28, 1939	1,370	2.5	11.4	83.5	.6	4	7.5	25	103	
Do	do	Feb. 5, 1940	380	2.0	13.5	97.4	.9	[1]	7.8	13		

Do	do	Feb. 13, 1940	12,800	5.5	13.0	102.8	2.0	24	7.5		85	
Do	do	Feb. 20, 1940	20,700	4.5	12.2	91.1	1.9	43	7.5	380	66	
Do	do	Feb. 27, 1940	6,150	5.0	12.7	99.4	.9	15	7.6	85	78	
Do	do	Mar. 4, 1940	56,600	7.5	9.8	81.1	2.8	93	7.5	1,000	52	
Do	do	Mar. 8, 1940	11,300	6.0	11.6	93.0	.9	23	7.5	250	53	
Do	do	Mar. 15, 1940	6,870	5.0	11.8	92.4	.9	46	7.5	195	69	
Do	do	Mar. 21, 1940	13,900	7.0	12.2	100.3	1.8	8	7.5	190	59	
Do	do	Mar. 29, 1940	3,050	9.0	11.8	101.4	1.1	2	7.5	70	68	
Do	do	Apr. 4, 1940	15,200	13.0	10.3	97.2	1.4	24	7.3	310	54	
Do	do	July 22, 1940	3,120	26.0	7.4	90.3	2.1	23	7.4	100	59	
Do	do	July 24, 1940	1,840	27.0	7.2	89.5	1.9	4	7.5	55	60	
Do	do	July 26, 1940	1,570	27.5	6.9	86.5	2.2	24	7.5	95	62	
Do	do	July 18, 1940	7,510	25.5	7.8	94.0	1.6	23	7.4	82	58	
Do	do	July 22, 1940	3,120	25.5	7.5	90.6	2.1	23	7.4	110	63	
Do	do	July 24, 1940	1,840	27.5	7.2	89.9	1.8	43	7.5	56	59	
Do	do	July 26, 1940	1,570	27.5	7.0	87.6	1.8	24	7.5	70	62	
Do	do	Oct. 15, 1940	2,160	18.5	7.4	78.6	1.3	4	7.5	13	63	
Do	do	Oct. 17, 1940	2,040	17.0	9.6	98.2	1.9	110	7.7	15	59	
Do	do	Jan. 17, 1941	4,320	5.0	12.4	96.6	2.6	9	7.3	40	73	
Do	do	Jan. 21, 1941	3,060	5.5	12.2	96.8	3.6	4	7.3	88	81	110
Do	do	Jan. 23, 1941	2,580	4.5	12.4	95.3	3.1	46	7.5	99	83	

[1] Less than 1.

LICKING RIVER BASIN

CONTENTS

	Page
Contents	691
Syllabus and conclusions	693
Description	694
Presentation of field data	695
Presentation of laboratory data	696
Hydrometric data	698
Discussion	699

LIST OF TABLES

L-1.—Cost estimates of remedial measures	694
L-2.—Surface-water supplies	695
L-3.—Sources of pollution	696
L-4.—Industrial wastes	696
L-5.—Selected laboratory data	697
L-6.—Monthly mean summer flows	698
L-7.—Summary of laboratory data	700

LIST OF FIGURES

L-2. Chart—Sources of pollution and selected laboratory data	696

(NOTE.—For maps of this basin see Kentucky River Basin.)

LICKING RIVER BASIN [1]

Syllabus and Conclusions

SYLLABUS

The Licking River drains 3,670 square miles in northeastern Kentucky, part of which is mountainous but most of which is in the fertile Bluegrass section. The basin is primarily an agricultural area; there are no large cities and most of the population is rural. The two largest towns have installed sewage-treatment plants. The remaining sources of pollution, all of them small, present no particularly difficult problems. Flow regulation by use of proposed flood control reservoirs will have no important effect on the pollution problem.

CONCLUSIONS

(1) Thirteen of the seventeen public water supplies in the basin come from surface sources. Two of these are seriously affected by sewage pollution.

(2) A total of 25,200 people are connected to sewers and 11,200 to the two sewage-treatment plants in the basin. Industrial wastes from seven small plants have a population equivalent of 3,300. The population equivalent of all sewage and industrial wastes as discharged is 18,900.

(3) Laboratory data indicate rather rapid recovery of the streams from the effects of pollution. A number of the smaller tributaries are grossly polluted in the vicinity of the sewer outfalls.

(4) Available waste treatment methods can restore the streams of the basin to satisfactory conditions.

(5) A summary of cost estimates of remedial measures from table L–1 follows:

Treatment	Capital cost	Annual cost
Existing	$290,000	$30,000
Suggested additional	710,000	70,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual cost
Primary, all places	$500,000	$45,000
Secondary, all places	740,000	75,000

[1] For maps of this basin, see Kentucky River Basin.

TABLE L–1.—*Licking River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative cost for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	0	2	11,200	$290,000	$20,000	$10,000	$30,000
Suggested minimum correction:							
Sewage-treatment plants	2	11	14,000	520,000	36,000	24,000	60,000
Required interceptors				180,000	8,000		8,000
Independent industrial waste correction				10,000	1,000	1,000	2,000
Total				710,000	45,000	25,000	70,000
Comparative cost:							
Primary treatment all waste				500,000	30,000	15,000	45,000
Secondary treatment all waste				740,000	50,000	25,000	75,000
As suggested				710,000	45,000	25,000	70,000

DESCRIPTION

The Licking Basin comprises 3,670 square miles of northeastern Kentucky immediately to the north and east of the Kentucky Basin which it resembles topographically and culturally. The headwaters are in a mountainous area and the western and northern portions of the basin are in the Bluegrass section. Agriculture is the principal industry. There are only four urban communities in the basin outside of Campbell and Kenton Counties at the mouth of the river. These counties are in the Cincinnati metropolitan area and their population is omitted from the following summary.

	Populations			
	1910	1920	1930	1940
Urban communities:				
Winchester	7,156	8,333	8,233	8,594
Paris	5,859	6,310	6,204	6,697
Cynthiana	3,603	3,857	4,386	4,840
Mount Sterling	3,932	3,995	4,350	4,782
Basin:				
Rural	149,724	144,209	138,639	145,230
Urban	20,550	22,495	23,173	24,913
Total	170,274	166,703	159,812	170,143

The only important tributary is the South Fork, which drains about 950 square miles of the Bluegrass section and joins the main stream at Falmouth (mile 51). All four of the urban communities are in the area drained by the South Fork.

Water uses.—The Licking River is not considered a navigable stream. There are no flood-control or hydroelectric reservoirs in the basin. Most of the streams of the basin are used for fishing and

bathing by local residents, but there are no outstanding recreational developments.

PRESENTATION OF FIELD DATA

Figure Ky-1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure L-2 shows similar data and, in addition, the location of water-supply intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand.

Public water supplies.—Thirteen of the seventeen communities with public water supplies depend on surface sources. The 4 underground supplies serve 1,700 people and the 13 surface supplies serve 36,200. Five of the surface supplies are from streams below sources of pollution, while the other 8 are from small impounding reservoirs or from creeks above the entrance of any sewage. Table L-2 shows data on the surface-water supplies of the basin.

TABLE L-2.—*Licking River Basin: Surface water supplies*

Supply	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls				
Falmouth	Licking River	51.3	FD	2,100	0.30
Cynthiana	South Fork Licking River	82	FD	4,500	.45
Millersburg	Hinkston Creek	100	CD	900	.02
Paris	Stoner Creek	101	FD	6,500	.80
Winchester	Impounded—Kentucky River [3]		FD	9,000	.45
	Other surface supplies				
Owingsville	Slate Creek	155	FD	500	.02
Mount Sterling	do	175	FD	4,800	.23
Morehead	Triplett Creek	179	FD	3,000	.15
Walton	Impounded		CD	700	.03
Williamstown	do		FD	1,200	.04
Carlisle	do		FD	1,800	.04
Flemingsburg	do		FD	900	.02
Alexandria [4]	do		FD	300	.01
Total:					
Below sewer outfalls				23,000	2.02
Other				13,200	.54
Total, surface water supplies				36,200	2.56

[1] Miles above mouth of Licking River.
[2] F=Coagulated, settled, filtered; D=Chlorinated; C=Coagulated, settled.
[3] Emergency intake in Kentucky River (mile 180).
[4] Under construction (1941).

Sewerage.—Table L-3 shows the sewered population at each of the more important sources of pollution. Of the 25,200 people connected to sewers, about 45 percent are connected to the two sewage treatment plants in the basin.

TABLE L-3.—*Licking River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Stream	Miles above mouth of Licking River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Falmouth	Licking River	51	1,000	None	1,100	1,100
Salyersville	do	274	500	do	500	500
Cynthiana	South Fork Licking River.	82	4,300	do	4,700	4,700
Lair	do	88			1,800	1,800
Paris [1]	do	100	4,900	Secondary	4,900	700
Walton	Cruise Creek	35	200	None	900	900
Millersburg	Hinkston Creek	100	500	do	500	500
Mount Sterling	do	125	3,300	do	3,500	3,500
Winchester	Strode's Creek	120	6,300	Secondary	6,400	1,000
Flemingsburg	Town Branch Fleming Creek.	129	500	None	500	500
Morehead	Triplett Creek	179	2,300	do	2,300	2,300
Small sources (5 towns)			1,400	do	1,400	1,400
Total			25,200		28,500	18,900

[1] Treatment plant under construction at time of laboratory survey.

Industrial wastes.—There are seven small sources of industrial wastes in the basin outside the Cincinnati metropolitan area near the mouth of the Licking River. Table L-4 shows information on the waste-disposal practices of these plants.

TABLE L-4.—*Licking River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Meat	2	1	1	2	400
Milk	2	1	1	2	300
Miscellaneous	3	1	2	1	2,600
Waste unconnected municipal treatment	7	3	4	5	3,300
Waste connected to municipal treatment					0
Total industrial waste in basin					3,300

PRESENTATION OF LABORATORY DATA

The laboratory data are summarized in table L-7 (p. 700). Selected laboratory data at some of the more important points are shown in table L-5. Samples were collected over a period of several months at Newport, Latonia, Butler, Falmouth, and Cynthiana and analyzed at the Cincinnati laboratory. All other points shown were sampled from a mobile laboratory unit during the low-flow period from September to December 1939.

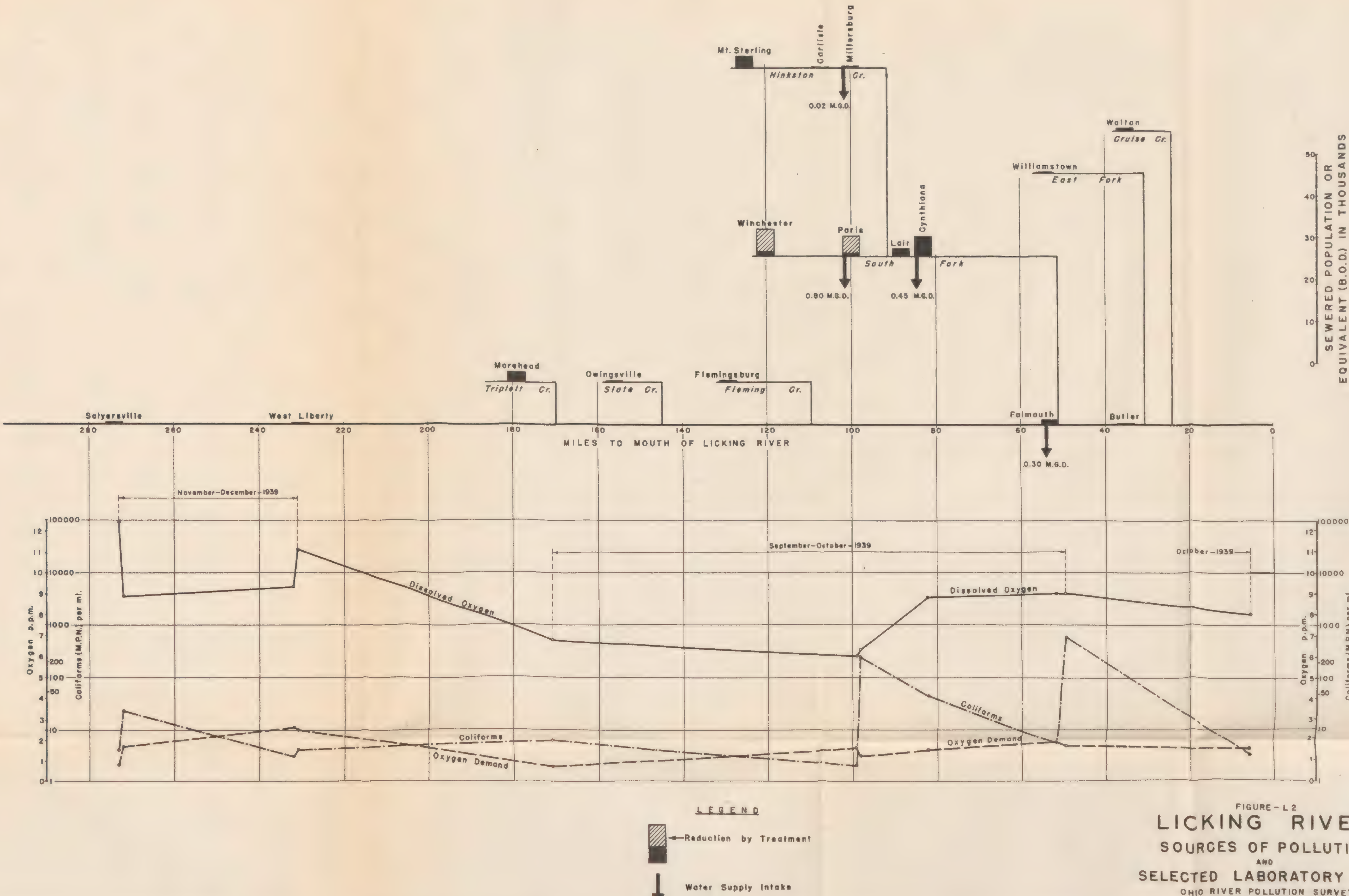


FIGURE - L 2
LICKING RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY DATA
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

TABLE L-5.—*Licking River Basin: Selected laboratory data*

River	Licking	Licking	Licking	Licking	Licking	Licking	Licking
Location	Above Salyersville	Below Salyersville	Bridge Farmers	Above Falmouth	Below Falmouth	Below Falmouth	Above Latonia
River miles above mouth of Licking.	273	272	171	51.5	49.4	49.4	5.5
Period, 1939	Nov. 27, 30	Nov. 30	Sept. 19, 21	July 10, 24	July 10, 24	Oct. 16	Oct. 9, 16
Number of samples	2	1	2	2	2	1	2
Flow in cubic feet per second:							
Sampling days	5	5	30	12,115	12,400	50	63
Minimum month	----------	----------	2.2	5.5	5.5	5.5	----------
Water temperature, °C	2.3	.5	20.5	25.5	25.3	11.5	15.8
Coliforms per mililiter	4	23	6	253	285	1,100	3
Dissolved oxygen, parts per million	12.4	8.9	6.8	6.4	6.8	9.9	8.0
Biochemical oxygen demand, 5-day, parts per million	.8	1.7	.7	2.5	2.1	1.5	1.5

River	Triplett Creek	Hinkston Creek	Strodes Creek	Stoner Creek	Stoner Creek	South Fork	South Fork
Location	Below Morehead	Below Mount Sterling	Below Winchester	Above Paris	Below Paris	Above Cynthiana	Below Cynthiana
River miles above:							
Confluence with Licking	9	73	68	49	47.5	30.5	29
Mouth of Licking	179	124	119	100	98.5	81.5	80
Period, 1939	Sept. 19, 21; Oct. 4	September	September	September	September	Sept. 13, Oct. 11	October
Number of samples	3	5	5	3	3	2	1
Flow in cubic feet per second:							
Sampling days	1	----------	----------	----------	----------	5	5
Water temperature, °C	20.3	20.2	18.9	22.5	23.3	20.8	20.5
Coliforms per milliliter	528	84,400	41,660	5	46,000	35	930
Dissolved oxygen, parts per million	2.5	0	1.0	6.7	0	4.3	1.6
Biochemical oxygen demand, 5-day, parts per million	4.3	31.6	20.7	1.7	44.9	2.2	24.5

Figures Ky–3, Ky–4, and Ky–5 (p. 676) show by means of symbols the coliform, dissolved oxygen and biochemical oxygen demand results at the various stations. The results thus shown are the averages of from one to three samples collected over short periods of less than 1 month at each of the mobile laboratory sampling points and indicate the most unfavorable monthly average at each of the points sampled from Cincinnati, where observations extended over a period of several months.

The laboratory observations show the worst conditions along the main Licking River occurring below Blue Lick Springs, Falmouth, and Butler. On the South Fork bad conditions were found below Winchester, Paris, and Cynthiana and below Mount Sterling and Millersburg on Hinkston Creek. Complete absence of dissolved oxygen was observed at Mount Sterling and Paris and averages of 1.2 and 1.0 parts per million were observed below Millersburg and Winchester. Less than 3.0 parts per million were found at Carlisle and Morehead. The coliform observations are in general agreement with the dissolved oxygen and oxygen demand results as indicators of the major sources of pollution. There is a tendency for the coliforms to indicate a somewhat heavier degree of pollution than the dissolved oxygen at some stations as is shown by the results at Flemingsburg, Morehead, Blue Lick Springs, and Falmouth.

The 5-day biochemical oxygen demand results for the most part lie within a range of from about 1 to 3 parts per million except immedi-

ately below sources of pollution and here the average values did not generally tend to exceed 5 or 6 parts per million, except below Mount Sterling with 31.6 parts per million, Carlisle with 16.5 parts per million, Winchester with 20.7 parts per million, Paris with 44.9 parts per million, Cynthiana with 24.5 parts per million, and Newport with 12.1 parts per million in January 1940. The pH ranged generally between about 7.0 to 8.0. The alkalinities varied from about 50 to 300 parts per million and the hardness ranged from 100 to 200 parts per million where these determinations were made.

Where samples were taken over a period of months the indications were that the coliforms and the oxygen demand reached their lowest concentrations during the low-water months from September through December 1939. This is true above Falmouth and Latonia and is indicative of the effects of long flow times upon the natural purification phenomenon.

The laboratory observations indicate that the natural recovering processes clear the stream in this basin within relatively short distances below sources of pollution at times of low flows. Such indications are not shown in those stretches at which increased flows were also observed.

Biological summary.—The plankton population of the Licking, as a whole, is not high, usually less than 1,000 parts per million except below Paris and Cynthiana, where the effects of pollution are indicated by an increase in total plankton.

Hydrometric Data

Seven stream gaging stations have been maintained on the Licking and the South Fork for various periods, only one of which is in operation at the present time. Table L–6 shows monthly mean summer flows during some of the low-flow years.

TABLE L–6.—*Licking River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Licking	South Fork, Licking
Location	At Catawba, Ky.	At Hayes, Ky.
River miles above—		
Confluence with Licking River		3
Mouth of Licking River	48	55
Drainage area (square miles)	3,300	922
Period of record	1928–40	1928–31
Year	1930	1930
June ... cubic feet per second	94.1	14.5
July ... do	17.0	.7
August ... do	13.7	0
September ... do	11.6	0
Year	1936	1931
June ... cubic feet per second	95.3	56.1
July ... do	29.5	271
August ... do	198	124
September ... do	440	68.1
Year	1937	1929
June ... cubic feet per second	1,505	398
July ... do	626	1,200
August ... do	343	81.6
September ... do	87.4	570

Low-flow regulation.—A study of a proposed flood-control program, involving reservoirs on the main Licking River at Falmouth and Cave Run, has been made by the United States Engineer Department and consideration has been given to pollution control through multipurpose use of these reservoirs.

Although seasonal low-flow control incidental to reservoir operations conducted primarily for other purposes is both beneficial and desirable, studies indicate that no reduction in the degree of treatment required under present conditions will be possible. Hence, little tangible value can be assigned to this added stream discharge.

Discussion

The pollution problems of the Licking River Basin are largely local ones and are concentrated in the area drained by the South Fork. Because of the low flows to which the streams are subject, secondary treatment will be required at most of the communities except Falmouth and Butler, where primary treatment will be suficient. The water supplies at Millersburg and at Cynthiana are subject to rather heavy pollution. At Millersburg better water treatment facilities are needed and the water intake is subject to pollution by drainage from the town itself. Improvements and enlargements are needed at the Winchester sewage treatment plant.

The estimated cost of the suggested pollution abatement program is shown in table L–1 (p. 694), together with estimates of the cost of treatment works already constructed and for comparative programs of primary treatment everywhere and of secondary treatment everywhere.

TABLE L-7.—*Licking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Licking River, above all sewage, Salyersville.	Li 273	Nov. 27, 1939	5	0.5	13.1	90.9	0.7	3	7.0	5	38	
Do	do	Nov. 30, 1939	5	4.0	11.7	89.1	.8	4	7.0	7	44	
Licking River, upper edge of Salyersville, Ky.	Li 272.5	Nov. 20, 1939	5	9.0	8.0	68.9	Lost	93	6.9	6	41	92
Licking River, 200 feet below last sewage outlet, Salyersville, Ky.	Li 272	Nov. 30, 1939	5	4.5	8.9	68.9	1.7	23	6.8	7	43	
Licking River, ¼ mile below Salyersville, Ky.	Li 271.8	Nov. 27, 1939	5	.5	11.0	76.2	2.4	93	6.9	9	43	
Licking River, 1 mile below Salyersville, Ky.	Li 271	Nov. 20, 1939	5	9.0	8.3	71.6	Lost	23	7.0	9	45	148
Licking River, above West Liberty, Ky.	Li 232	Nov. 20, 1939	27	8.0	7.9	66.4	Lost	4	6.8	18	45	107
Do	do	Nov. 27, 1939	27	.5	9.4	65.0	4.2	1	6.9	20	45	
Do	do	Nov. 30, 1939	27	4.0	10.7	81.6	1.0	4	6.9	15	44	
Licking River, lower edge of West Liberty, Ky.	Li 321.5	Nov. 27, 1939	27	2.5	10.9	79.7	4.0	4	7.0	8	47	
Do	do	Nov. 30, 1939	27	4.0	11.3	86.0	2.5	4	7.0	12	47	
Licking River, ¼ mile below West Liberty, Ky.	Li 231	Nov. 20, 1939	27	8.5	8.7	74.2	Lost	23	7.0	22	48	97
Licking River, bridge, Farmers, Ky.	Li 171	Sept. 19, 1939	30	20.5	6.5	71.5	.6	4	7.3	14	56	
Do	do	Sept. 21, 1939	30	20.5	7.0	77.3	.7	9	7.2	23	58	
Triplett Creek, 1 mile below Morehead, Ky.	LiT 178	Sept. 19, 1939		20.5	2.2	23.8	3.3	23	6.9	11	57	
Do	do	Sept. 21, 1939		21.0	3.1	34.3	6.8	1,100	7.0	25	69	
Do	do	Oct. 11, 1939		19.5	2.2	23.8	2.8	460	6.9	12	70	123
Town Branch, Fleming Creek 1 mile below Flemingsburg, Ky.	LiFt 129	Sept. 19, 1939	1	20.0	5.9	64.3	8.0	150	7.8	36	149	
Do	do	Sept. 22, 1939	1	20.5	7.6	84.3	2.9	93	7.6	32	150	
Do	do	Oct. 11, 1939	1	17.5	7.4	77.0	2.7	240	7.7	27	201	218
Licking River, upper edge Blue Lick Springs.	Li 99	Sept. 18, 1939	48	23.5	5.9	68.8	2.3	2	7.5	32	80	
Do	do	Sept. 20, 1939	48	23.5	6.1	70.8	1.0	2	7.5	40	79	
Licking River, upper edge Blue Lick Springs.	Li 98	Sept. 18, 1939	49	23.5	6.3	72.9	1.3	240	7.4	37	80	
Licking River, bridge above Claysville, Ky.	Li 82	Sept. 18, 1939	73	26.0	8.5	103.2	1.7	46	7.9	54	86	
Do	do	Sept. 20, 1939	73	24.0	9.1	106.3	1.3	46	7.9	51	84	

Hinkston Creek, ½ mile above Mount Sterling, Ky.	LiFH 126	Sept. 12, 1939		20.5	9.1	100.2	5.4	36	7.9	80	144	
Do	do	Sept. 14, 1939		24.0	4.5	52.6	6.9	2	7.7	61	133	
Hinkston Creek, 1 mile below Mount Sterling, Ky.	LiSfH 124	Sept. 12, 1939		21.0	0	0	34.3	46,000	7.5	32	323	
Do	do	Sept. 14, 1939		26.0	0	0	43.6	110,000	7.6	30	329	
Do	do	Sept. 19, 1939		19.5	0	0	18.0	46,000	7.6	15	339	
Do	do	Sept. 21, 1939		19.0	0	0	21.0	110,000	7.5	15	272	
Do	do	Sept. 22, 1939		15.5	0	0	41.1	110,000	7.5	28	322	
Hinkston Creek, 3 miles below Mount Sterling, Ky.	LiSfH 122	Sept. 21, 1939		19.0	3.2	34.0	7.3	290	7.6	26	261	
Do	do	Sept. 22, 1939		15.5	2.8	28.2	29.5	36	7.5	47	242	
Hinkston Creek, 1 mile above Millersburg, Ky.	LiSfH 101	Sept. 15, 1939		25.5	14.7	176.9	7.1	15	8.7	32	147	
Do	do	Sept. 18, 1939		22.0	5.9	66.9	4.5	110	7.6	55	154	
Do	do	Sept. 20, 1939		23.5	10.2	118.1	4.9	24	7.9	51	154	
Hinkston Creek, upper edge Millersburg, Ky.	LiSfH 100	Oct. 11, 1939		19.5	2.2	23.9	4.9	240	7.4	43	177	209
Hinkston Creek, 300 feet below last sewage outlet, Millersburg, Ky.	LiSfH 99	Oct. 11, 1939		17.5	1.2	12.9	5.9	1,100	7.4	9	172	196
Hinkston Creek, 1 mile below Millersburg, Ky.	LiSfH 98	Sept. 13, 1939		21.5	3.9	43.5	3.9	240	7.6	20	143	
Do	do	Sept. 15, 1939		24.5	2.7	31.6	2.5	43	7.5	15	147	
Do	do	Sept. 18, 1939		20.5	1.9	20.7	2.5	4	7.4	13	148	
Do	do	Sept. 20, 1939		21.5	2.0	22.0	2.8	4	7.4	22	152	
Brush Fork Creek, upper edge of Carlisle, Ky.	LiSfH 108	Sept. 13, 1939		27.0	2.6	32.6	16.5	36	7.7	137	212	
Scrub Grass Creek, above Carlisle, Ky.	LiSfBS 109	Sept. 15, 1939		21.5	3.4	38.7	16.2	12	8.4	76	181	
Brush Fork Creek, ½ mile below Carlisle, Ky.	LiSfB 107	Sept. 19, 1939		20.5	6.8	74.3	3.2	110	7.8	37	142	
Do	do	Oct. 11, 1939		17.0	4.9	50.7	3.5	75	7.6	50	161	172
Brush Fork Creek, 1 mile below Carlisle, Ky.	LiSfB 106	Sept. 13, 1939		25.5	7.4	88.8	1.5	23	7.6	15	140	
Do	do	Sept. 15, 1939		24.5	3.2	37.5	2.6	8	7.6	27	147	
Stoner Creek, above dam, North Middletown, Ky.	LiSfS 111	Sept. 14, 1939		25.5	5.4	65.3	.1	15	7.8	25	148	
Strodes Creek, edge of town, above Winchester, Ky.	LiSfS 121	Sept. 12, 1939		16.0	4.1	41.3	3.0	36	7.6	20	370	
Do	do	Sept. 14, 1939		22.0	2.7	30.7	4.3	110	7.6	20	364	
Strodes Creek, 1 mile below Winchester, Ky.	LiSfS 119	Sept. 12, 1939		19.5	3.8	41.0	8.4	24,000	7.7	35	349	
Do	do	Sept. 14, 1939		21.5	.5	5.4	14.5	4,300	7.6	23	325	
Do	do	Sept. 19, 1939		20.0	0	0	42.2	24,000	7.2	110	110	
Do	do	Sept. 21, 1939		19.5	.3	3.6	19.9	110,000	7.6	17	285	
Do	do	Sept. 22, 1939		14.0	.5	5.2	18.3	46,000	7.6	25	311	
Strodes Creek, 4 miles below Winchester, Ky.	LiSfS 116	Sept. 21, 1939		19.0	3.4	35.9	3.1	36	7.6	20	211	
Do	do	Sept. 22, 1939		17.0	3.6	36.4	3.1	4	7.6	22	218	

TABLE L-7.—*Licking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Stoner Creek Power Plant, above Paris, Ky.	LiSfSt 100	Sept. 12, 1939		24.5	6.9	81.3	1.5	4	7.8	12	165	
Do	do	Sept. 14, 1939		20.0	7.0	76.0	1.4	9	7.8	13	162	
Do	do	Sept. 19, 1939		23.0	6.2	71.3	2.4	2	7.8	13	165	
Stoner Creek, 200 yards below sewage, Paris, Ky.	LiSfSt 98.5	Sept. 20, 1939		24.5	0	0	51.4	46,000	7.4	54	234	
Do	do	Sept. 21, 1939		23.5	0	0	42.2	46,000	7.5	66	240	
Do	do	Sept. 22, 1939		22.0	0	0	41.2	46,000	7.4	51	238	
Stoner Creek, ½ mile below sewage, Paris, Ky.	LiSfSt 98.2	Sept. 12, 1939		20.5	5.1	55.7	5.3	36	7.8	30	191	
Do	do	Sept. 14, 1939		22.0	3.3	36.9	4.1	4	7.7	15	187	
Stoner Creek, 1 mile below sewage, Paris, Ky.	LiSfSt 97.5	Sept. 19, 1939		21.5	1.4	15.7	7.5	24	7.6	13	211	
South Fork, Licking River, at lower bridge, above Lair, Ky.	LiSf 89	Sept. 13, 1939	5	21.5	5.4	61.1	2.2	4	7.9	76	154	
Do	do	Sept. 15, 1939	5	24.0	5.8	67.4	1.8	9	7.9	41	154	
South Fork, Licking River, 1 mile below Lair, Ky.	LiSf 88	Sept. 13, 1939	5	24.5	6.7	79.3	1.6	3	7.8	76	151	
Do	do	Sept. 15, 1939	5	24.0	6.4	74.6	1.9	12	7.8	56	154	
Do	do	Sept. 18, 1939		23.5	5.9	68.6	2.7	9	7.8	90	156	
South Fork, Licking River, 1 mile above Cynthiana, Ky.	LiSf 82	Sept. 15, 1939	5	25.5	7.3	87.6	2.2	15	8.0	33	155	
Do	do	Sept. 18, 1939	5	24.5	7.1	83.8	4.1	4	7.9	49	161	
Do	do	Sept. 20, 1939	5	21.0	5.0	56.1	4.7	4	7.9	55	158	
South Fork, Licking River, upper edge Cynthiana, Ky.	LiSf 81.5	Sept. 13, 1939	5	22.0	4.2	48.0	1.5	23	7.6	39	165	
Do	do	Oct. 11, 1939	5	19.5	4.4	47.8	2.8	46	7.6	15	182	210
South Fork, Licking River, 1 mile below Cynthiana, Ky.	LiSf 80	Sept. 13, 1939	5	24.0	9.5	111.1	4.4	7	8.2	33	144	
Do	do	Sept. 15, 1939		25.3	12.7	152.1	3.0	2	8.6	22	143	
Do	do	Oct. 11, 1939	5	20.5	1.6	17.1	21.5	930	7.4	44	158	180
South Fork, Licking River 1½ miles below Cynthiana, Ky.	LiSf 79.5	Sept. 18, 1939	4	24.0	9.3	108.8	5.8	1	8.1	20	153	
Do	do	Sept. 20, 1939	4	21.5	6.1	68.0	2.7	24	7.9	37	150	
South Fork, Licking River, bridge in town, Cynthiana, Ky.	LiSf 81	Feb. 17, 1939		6.5	11.6	94.5	1.6	240				
Do	do	Feb. 24, 1939		4.5	12.4	95.4	1.1	93				
Do	do	Mar. 1, 1939		7.0	11.0	90.0	2.7	75				
Do	do	Mar. 6, 1939		9.5	9.8	85.[illegible]	3.1	93				
Do	do	Mar. 14, 1939		10.5	10.1	90.4	1.6	43				

Do	do	Mar. 22, 1939		11.0	11.2	101.4	1.2	7				
Do	do	Mar. 30, 1939		10.0	10.4	92.1	3.8	240				
Do	do	Apr. 5, 1939		10.5	10.6	94.5	1.2	24				
Do	do	Apr. 11, 1939		12.0	10.1	93.1	1.0	9				
Do	do	Apr. 21, 1939		11.0	10.4	93.8	.4	93				
Do	do	Apr. 27, 1939		19.0	8.8	94.7	.7	4				
Do	do	May 3, 1939		15.5	9.6	95.7	1.3	24				
Do	do	Apr. 9, 1939		18.5	10.0	105.6	3.9	46				
Do	do	Apr. 17, 1939		19.0	10.7	114.8	4.5	4				
Do	do	Apr. 25, 1939		26.0	7.0	85.8	2.4	24				
Do	do	Apr. 31, 1939		26.0	5.3	64.8	4.0	240				
Do	do	June 6, 1939		24.5	8.8	104.7	4.0	460				
Do	do	June 12, 1939		23.0	6.6	76.5	1.8	43				
South Fork, Licking River, Berry, Ky.	LiSf 69	Sept. 20, 1939	4	21.0	6.8	75.8	2.2	9	7.8	50	133	
South Fork, Licking River, bridge on US 27, above Falmouth, Ky.	LiSf 52	Feb. 17, 1939		7.5	11.6	96.8	3.1	93				
Do	do	Feb. 24, 1939		5.5	12.8	101.1	1.5	43				
Do	do	Mar. 1, 1939		7.0	11.6	94.9	1.7	43				
Do	do	Mar. 6, 1939		9.0	10.4	90.2	3.3	93				
Do	do	Mar. 14, 1939		11.0	10.7	96.3	2.3	23				
Do	do	Mar. 22, 1939		10.0	11.4	100.7	.8	4				
Do	do	Mar. 30, 1939		9.0	10.7	92.4	3.7	150				
Do	do	Apr. 5, 1939		9.0	11.0	94.8	1.5	110				
Do	do	Apr. 11, 1939		11.5	10.4	93.4	1.6	93				
Do	do	Apr. 21, 1939		11.0	10.5	94.4	1.4	93				
Do	do	Apr. 27, 1939		18.5	8.6	91.4	1.3	43				
Do	do	May 3, 1939		15.5	13.2	131.8	4.8	4				
Do	do	May 9, 1939		19.5	8.8	94.8	2.1	2				
Do	do	May 17, 1939		20.0	9.6	105.1	2.5	4				
Do	do	May 25, 1939		25.5	7.0	84.1	1.6	24				
Do	do	May 31, 1939		27.5	8.7	109.3	3.3	2				
Do	do	June 6, 1939		24.0	7.5	87.7	2.0	24				
Do	do	June 12, 1939		21.5	6.9	77.7	3.1	240				
Do	do	June 26, 1939		None	7.4		1.8	240				
Do	do	July 10, 1939		25.0	7.3	87.1	2.0	460				
Do	do	July 24, 1939		26.5	7.5	92.1	1.8	24				
Do	do	Aug. 7, 1939		23.5	7.2	83.6	1.5	46				
Do	do	Aug. 21, 1939		24.5	7.0	82.6	1.2	460	7.8			
Do	do	Sept. 18, 1939	29	20.0	7.1	77.1	1.1	24	7.8			
Do	do	Oct. 16, 1939	27	10.0	10.2	90.0	1.2	15	8.0			
Do	do	Nov. 13, 1939	24	5.0	11.3	88.0	1.2	9	7.6			
Do	do	Dec. 22, 1939		0	13.3	91.1	.9	4	7.7			
Do	do	Jan. 16, 1940		0	13.8	94.4	3.7	1,100	7.6			
Do	do	Jan. 29, 1940		0	13.6	93.3	1.3	4	7.6			
Do	do	Feb. 6, 1940		1.0	13.1	92.2	6.2	150	7.5			
Do	do	Feb. 14, 1940		4.5	12.5	96.3	1.5	43	7.5			
Do	do	Feb. 20, 1940		7.0	11.6	95.6	2.2	29	7.5			
Do	do	Feb. 27, 1940		6.0	12.8	102.7	1.1	15	7.5			
Do	do	Mar. 4, 1940		11.0	9.8	88.4	3.2	460	7.5			
Do	do	Mar. 8, 1940		6.0	11.9	95.4	.9	23	7.6			
Do	do	Mar. 14, 1940		5.0	12.2	95.4	.8	9	7.7			

TABLE L-7.—*Licking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
South Fork, Licking River, bridge on US 27, above Falmouth, Ky.	LiSf 52	Mar. 21, 1940		10.0	12.3	108.4	0.7	4	7.9			
Do	do	Mar. 29, 1940		12.0	10.9	100.9	.9	1	8.2			
Licking River bridge on Kentucky Route No. 22 above Falmouth, Ky.	Li 51	Feb. 17, 1939		8.0	11.5	96.6	2.4	23				
Do	do	Feb. 24, 1939		5.5	11.8	93.8	1.3	4				
Do	do	Mar. 1, 1939		7.0	11.5	94.2	1.3	23				
Do	do	Mar. 6, 1939		8.5	10.5	89.8	3.1	93				
Do	do	Mar. 14, 1939		11.5	10.4	94.4	1.6	93				
Do	do	Mar. 22, 1939		9.5	11.5	100.6	.7	3				
Do	do	Mar. 30, 1939		10.0	10.6	93.9	2.2	43				
Do	do	Apr. 5, 1939		10.0	11.0	96.6	1.0	110				
Do	do	Apr. 11, 1939		11.5	11.0	100.0	.8	9				
Do	do	Apr. 21, 1939		12.0	9.9	91.7	1.0	23				
Do	do	Apr. 27, 1939		18.0	8.7	91.1	1.2	93				
Do	do	May 3, 1939		15.5	9.6	95.0	1.0	15				
Do	do	May 9, 1939		19.0	9.7	103.5	1.8	4				
Do	do	May 17, 1939		20.5	9.3	102.1	1.7	2				
Do	do	May 25, 1939		25.5	7.1	85.2	1.7	5				
Do	do	May 31, 1939		26.5	6.6	81.3	1.6	24				
Do	do	June 6, 1939		25.0	6.9	82.1	1.3	15				
Do	do	June 12, 1939		22.5	7.0	79.7	2.2	460				
Licking River, above sewers, above Falmouth, Ky.	Li 51.5	June 26, 1939	1,080	None	7.3		3.4	110				
Do	do	July 10, 1939		25.0	5.3	63.7	4.2	460				
Do	do	July 24, 1939		26.0	7.4	90.4	.8	46				
Do	do	Aug. 7, 1939		24.0	7.2	85.0	.8	46				
Do	do	Aug. 21, 1939		24.0	6.2	72.8	1.4	240	7.6			
Do	do	Sept. 18, 1939	56	23.5	8.2	95.0	2.1	4	8.0			
Do	do	Oct. 16, 1939	44	12.0	9.8	90.5	1.6	5	7.9			
Do	do	Nov. 13, 1939	51	6.0	11.6	92.6	1.4	2	7.5			
Do	do	Dec. 22, 1939		1.0	13.0	91.0	1.7	2	7.5			
Do	do	Jan. 16, 1940		0	13.8	94.2	2.6	46	7.7			
Do	do	Jan. 29, 1940		0	13.8	94.4	2.2	9	7.6			
Do	do	Feb. 6, 1940		0	13.0	89.1	2.4	21	7.5			
Do	do	Feb. 14, 1940		1.5	12.5	88.9	1.8	23	7.5			
Do	do	Feb. 20, 1940		6.0	11.1	89.0	1.8	23	7.5			
Do	do	Feb. 27, 1940		7.0	12.7	104.5	1.1	9	7.8			
Do	do	Mar. 4, 1940		10.0	10.3	90.9	3.0	240	7.5			
Do	do	Mar. 8, 1940		8.0	11.4	95.7	.9	43	7.5			

Do	do	Mar. 14, 1940		5.0	12.4	96.6	1.9	2	7.6			
Do	do	Mar. 21, 1940		10.5	11.2	100.1	.8	3	7.8			
Do	do	Mar. 29, 1940		11.0	11.4	102.9	.4	2	7.6			
Licking River, below Falmouth, Ky	Li 49.4	June 26, 1939	2,400	None	7.4		2.0	110				
Do	do	July 10, 1939		25.0	6.2	73.6	2.4	460				
Do	do	July 24, 1939		25.5	7.4	89.2	1.7	110				
Do	do	Aug. 7, 1939		23.5	7.1	82.6	1.4	150				
Do	do	Aug. 21, 1939		24.5	6.4	75.5	1.6	460	7.5			
Do	do	Sept. 18, 1939	55	22.5	8.0	91.4	1.9	110	7.9			
Do	do	Oct. 16, 1939	50	11.5	9.9	90.5	1.5	1,100	7.9			
Do	do	Nov. 13, 1939	80	5.5	11.5	91.2	1.3	43	7.5			
Do	do	Dec. 22, 1939		1.0	None		1.5	93	7.5			
Do	do	Jan. 29, 1940		0	13.8	94.2	5.0	110	7.5			
Do	do	Feb. 6, 1940		0	13.2	90.1	4.8	43	7.5			
Licking River, bridge on US 27, Butler, Ky.	Li 35	Feb. 17, 1939	29,600	7.5	11.6	96.4	2.5	20				
Do	do	Feb. 24, 1939	6,770	5.5	12.0	94.9	1.3	9				
Do	do	Mar. 1, 1939	17,375	6.0	11.5	91.9	1.8	43				
Do	do	Mar. 6, 1939	48,000	8.5	10.6	90.3	3.3	240				
Do	do	Mar. 14, 1939	21,000	10.5	10.3	91.8	1.8	23				
Do	do	Mar. 22, 1939	2,650	9.5	11.5	100.1	1.0	4	7.7	36	93	
Do	do	Mar. 30, 1939	13,810	9.5	10.6	92.2	3.1	93	7.6	950	81	
Do	do	Apr. 5, 1939	8,260	9.5	11.0	96.0	1.0	46	7.6	100	75	
Do	do	Apr. 11, 1939	7,060	11.0	10.7	96.8	.7	15	7.8	100	77	
Do	do	Apr. 21, 1939	20,200	11.5	9.9	90.6	1.1	43	8.0	180	59	
Do	do	Apr. 27, 1939	3,680	17.0	9.0	92.2	1.0	9	7.6	41	100	
Do	do	May 3, 1939	2,025	14.5	9.8	95.9	1.8	15	7.8	40	91	
Do	do	May 9, 1939	1,170	20.0	8.9	97.1	2.1	8	8.3	15	95	
Do	do	May 17, 1939	795	18.5	8.7	92.6	1.7	2	8.1	5	99	
Do	do	May 25, 1939	1,360	25.0	7.8	92.8	1.8	24	7.7	43	96	
Do	do	May 31, 1939	980	26.5	8.0	97.9	1.4	24	7.8	25	74	
Do	do	June 6, 1939	1,120	25.0	7.1	85.0	1.9	24	7.7	162	106	
Do	do	June 12, 1939	3,630	22.0	6.4	72.3	3.2	240	7.7	825	82	
Do	do	Feb. 20, 1940	26,800	7.0	12.0	98.4	2.2	240	7.5			
Do	do	Feb. 27, 1940	3,100	7.5	12.9	107.6	.9	23	7.6			
Do	do	Mar. 4, 1940	50,400	10.0	10.1	89.3	3.2	93	7.5			
Do	do	Mar. 8, 1940	8,800	7.0	11.4	93.9	1.0	93	7.5			
Do	do	Mar. 14, 1940	2,300	4.5	12.3	94.9	.9	8	7.6			
Do	do	Mar. 21, 1940	2,920	8.0	11.4	95.6	.9	15	7.8			
Do	do	Mar. 29, 1940	1,360	13.0	11.2	105.8	.6	9	7.6			
Licking River, Louisville & Nashville R. R. bridge, Latonia, Ky.	Li 3.3	Apr. 5, 1939	9,000	10.0	10.8	94.9	1.1	460				
Do	do	Apr. 11, 1939	7,690	11.5	10.6	96.7	1.5	210				
Do	do	Apr. 21, 1939	2,200	12.5	9.5	88.8	1.2	23				
Do	do	Apr. 27, 1939	4,000	17.5	8.9	91.9	.8	23				
Do	do	May 3, 1939	2,200	15.5	9.7	96.7	1.8	150				
Do	do	May 9, 1939	1,270	20.0	8.9	96.7	2.5	43				
Do	do	May 17, 1939	865	21.0	8.6	95.9	2.0	110				
Do	do	May 25, 1939	1,480	26.5	7.1	87.2	2.1	1,100				
Do	do	May 31, 1939	1,070	25.0	7.0	83.5	1.6	23				
Do	do	June 6, 1939	1,220	23.5	6.6	76.2	2.3	110				
Do	do	June 12, 1939	3,950	23.5	6.2	72.6	3.0	460				

TABLE L-7.—*Licking River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Licking River, above Banklick Creek, above Latonia, Ky.	Li 5.5	June 26, 1939	2,630	None	6.8		2.0	460	7.8	550	94	
Do	do	July 10, 1939	26,800	24.0	5.5	64.0	2.9	460				
Do	do	July 24, 1939	1,380	24.0	7.2	84.5	1.4	9				
Do	do	Aug. 7, 1939	1,620	23.5	6.7	78.1	1.6	46				
Do	do	Aug. 21, 1939	2,410	24.0	6.2	72.7	1.5	43	7.5			
Do	do	Sept. 11, 1939	141	21.5	6.5	73.0	1.6	7				
Do	do	Sept. 18, 1939	109	23.0	6.6	75.8	1.2	2	7.8			
Do	do	Oct. 9, 1939	64	19.0	8.0	85.9	1.8	2	7.9			
Do	do	Oct. 16, 1939	58	12.5	8.0	74.4	1.2	5	7.6			
Do	do	Nov. 6, 1939	192	6.0	11.3	90.5	1.0	4	7.7			
Do	do	Nov. 13, 1939	99	5.0	11.5	89.8	1.2	4	7.5			
Do	do	Dec. 15, 1939	127	2.5	12.3	90.3	2.6	9	7.6			
Do	do	Dec. 22, 1939	130	1.5	12.2	86.7	1.5	9	7.6			
Do	do	Jan. 16, 1940	4,950	0	13.1	89.3	4.4	110	7.7			
Do	do	Jan. 29, 1940	460	0	13.8	94.7	3.1	4	7.5			
Do	do	Feb. 6, 1940	4,200	1.0	13.2	93.0	6.6	240	7.5			
Do	do	Feb. 14, 1940	7,150	2.5	12.2	89.3	2.2	43	7.5			
Do	do	Feb. 20, 1940	29,200	5.0	12.1	94.8	2.4	93	7.5			
Do	do	Mar. 4, 1940	54,900	8.0	10.1	84.9	3.1	93	7.5			
Do	do	Mar. 8, 1940	9,580	7.0	11.3	92.8	1.0	23	7.5			
Do	do	Mar. 14, 1940	2,500	5.0	12.2	95.5	1.2	12	7.6			
Do	do	Mar. 21, 1940	3,180	7.5	11.2	93.5	1.4	4	7.9			
Do	do	Mar. 29, 1940	1,480	10.5	11.3	101.1	.9	4	7.6			
Licking River, mouth, Newport, Ky.	Li 0.4	Feb. 24, 1939	7,370	6.0	11.7	93.5	1.6	150				
Do	do	Mar. 1, 1939	18,900	7.0	11.6	94.9	2.2	93				
Do	do	Mar. 6, 1939	52,300	8.5	10.6	90.0	3.2	240				
Do	do	Mar. 14, 1939	22,900	12.0	10.0	92.7	2.7	93				
Do	do	Mar. 30, 1939	15,600	9.5	10.4	91.2	3.8	240				
Do	do	Jan. 16, 1940	4,950	0	12.9	88.2	18.7	460	7.6			
Do	do	Jan. 29, 1940	460	0	13.0	88.9	5.5	240	7.6			
Do	do	Feb. 6, 1940	4,200	2.0	11.4	82.2	10.1	1,100	6.8			
Do	do	Feb. 14, 1940	7,150	4.5	12.2	94.4	2.0	240	7.5			
Do	do	Feb. 20, 1940	29,200	7.5	12.1	100.3	2.5	240	7.5			
Do	do	Feb. 27, 1940	3,370	5.0	12.7	99.5	2.7	460	7.5			
Do	do	Mar. 4, 1940	54,900	8.0	9.8	82.9	2.9	93	7.5			
Do	do	Mar. 8, 1940	9,580	9.0	11.1	95.9	1.5	1,100	7.5			
Do	do	Mar. 14, 1940	2,500	5.0	12.2	95.1	1.5	1,100	7.6			
Do	do	Mar. 21, 1940	3,180	11.0	11.0	99.5	1.3	240	7.7			
Do	do	Mar. 29, 1940	1,480	13.0	11.2	105.7	2.2	240	7.5			

SALT RIVER BASIN

CONTENTS

	Page
Contents	709
Syllabus and conclusions	711
Description	712
Presentation of field data	713
Presentation of laboratory data	715
Hydrometric data	716
Discussion	717

LIST OF TABLES

St–1.—Cost estimates of remedial measures	712
St–2.—Surface water supplies	713
St–3.—Sources of pollution	714
St–4.—Industrial wastes	714
St–5.—Selected laboratory data	715
St–6.—Monthly mean flows	717
St–7.—Summary of laboratory data	718

LIST OF FIGURES

St–2.—Chart—Sources of pollution and selected laboratory data	714

(NOTE.—For maps of this basin see Kentucky River Basin.)

SALT RIVER BASIN [1]

Syllabus and Conclusions

SYLLABUS

The Salt River Basin comprises 2,890 square miles of the Bluegrass section in the north central part of Kentucky. The population of nearly 140,000 is predominantly rural, only 16,000 people living in the 4 towns of more than 2,500 population. All but one of the larger communities have sewage treatment plants. The most serious pollution problems are caused by wastes from the 24 distilleries. Although all of these have taken some steps to reduce the quantity and strength of their wastes, further corrective measures appear justified for the protection of aquatic life.

CONCLUSIONS

(1) Of 17 public water supplies, 15, serving 26,500 people, are from surface sources. Pollution is a minor problem in connection with these supplies.

(2) Sewage from about 20,300 people is discharged to the streams of the basin. About 85 percent of sewage is treated prior to discharge. Industrial wastes with a population equivalent of about 99,000 also reach the streams. Almost all of this waste is from distilleries.

(3) Laboratory observations show that the Salt River and its principal tributaries are not seriously polluted except immediately below the larger sources of pollution. The streams seem to recover rather quickly from the pollutional loads placed on them. Practically no distillery wastes were being discharged at the time of sampling.

(4) The limited records available indicate the following minimum flows:

	Cubic feet per second
Salt River at Shepherdsville	0. 4
Rolling Fork at Boston	16. 0
Beech Fork at Fredericktown	None

(5) Very little of the waste enters the larger streams directly. Most of the communities and industries are located on small tributaries which afford practically no dilution.

(6) All but one of the sewage treatment plants in the basin provide secondary treatment. Such treatment everywhere is indicated because of the lack of appreciable dilution.

(7) Treatment of distillery wastes by evaporation of the slop and ponding or broad irrigation of other wastes is needed at the larger plants. At others, improved ponding or irrigation facilities probably will suffice.

(8) The estimated cost of remedial measures as summarized from table St-1 follows:

Treatment	Capital cost	Annual cost
Existing	$670, 000	$80, 000
Suggested additional	460, 000	70, 000

[1] For maps of this basin, see Kentucky River Basin.

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual cost
Primary, all places	$380,000	$60,000
Secondary, all places	460,000	70,000

TABLE ST–1.—*Salt River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	1	7	17,100	$670,000	$48,000	$32,000	$80,000
Suggested minimum correction:							
Sewage treatment plants	0	7	3,200	200,000	14,000	10,000	24,000
Required interceptors				10,000	1,000		1,000
Independent industrial waste correction				250,000	41,000	4,000	45,000
Total				460,000	56,000	14,000	70,000
Comparative cost:							
Primary treatment all waste				380,000	50,000	10,000	60,000
Secondary treatment all waste				460,000	56,000	14,000	70,000
As suggested				460,000	56,000	14,000	70,000

DESCRIPTION

The Salt River Basin comprises 2,890 square miles of rolling land in north central Kentucky, most of which is the fertile agricultural land of the Bluegrass section. The Salt River joins the Ohio at West Point, Ky., about 25 miles below Louisville.

	Distance above mouth	Drainage area, square miles
Major tributaries:		
Rolling Fork (including Beech Fork)	12	1,470
Beech Fork	29	776
Floyds Fork	24	262

	Populations			
	1910	1920	1930	1940
Urban communities:				
Harrodsburg	3,147	3,765	4,029	4,673
Shelbyville	3,412	3,760	4,033	4,392
Lebanon	3,077	3,239	3,248	3,786
Bardstown	2,126	1,717	1,767	3,152
Entire basin:				
Urban	9,636	10,764	11,310	16,003
Rural	118,059	121,268	114,852	123,865
Total	127,695	132,032	126,162	139,868

Agriculture and whisky distilling are the principal industries of the area. Most of the 24 distilleries are small and are located in rural areas.

Water uses.—The Salt River is not navigable except near the mouth where it is influenced by backwater from the Ohio River. There are no flood-control or hydroelectric reservoirs in the basin. The lack of important towns along the larger streams lessens the need for flood control, and no reservoirs have been authorized. Many of the streams are used by local residents for fishing and bathing but the streams are not particularly attractive for recreation because of the extreme low flows which usually prevail during the summer.

Presentation of Field Data

Figure Ky–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure St–2 shows similar data and, in addition, the location of water supply intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen and biochemical oxygen demand.

Public water supplies.—All but 2 of the 17 public water supplies in the basin come from surface sources. The 2 underground supplies serve only 600 people while the surface supplies serve 26,500. Five of the surface supplies are from streams below sources of pollution while the other 10 are from small impounding reservoirs or from streams above the point of entrance of any sewage. Table St–2 shows data on the surface water supplies of the basin.

TABLE ST–2.—*Salt River Basin: Surface water supplies*

Supply	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls				
Shepherdsville	Salt River	25	FD	500	0.02
Taylorsville	do	57	FD	900	.06
Lawrenceburg	do	91	FD	2,100	.25
Lebanon Junction	Rolling Fork	23	FD	500	.02
New Haven	do	45	FD	300	.01
	Other surface supplies				
Lebanon	Rolling Fork	87	FD	3,500	0.18
Bradfordville	North Fork Rolling Fork (infiltration gallery).	95	None	200	.01
Shelbyville	Clear Creek, impounded	89	FD	4,000	.29
Fort Knox	Mill Creek-Otter Creek	15	FD	5,000	.70
Harrodsburg	Salt River	122	FD	4,500	.14
Bardstown	Impounded		FD	2,500	.22
Springfield	do		FD	1,600	.09
Lincoln Institute	do		FD	300	.03
Nazareth College	do		F	400	.02
St. Catherines Academy	do [3]		O	200	.02
Total:					
Below sewer outfalls				4,300	0.36
Other				22,200	1.70
Total surface water supplies				26,500	2.06

[1] Miles above mouth of Salt River.
[2] F=coagulated, settled, filtered; D=chlorinated.
[3] For inferior purposes only.

Sewerage.—Table St–3 shows the sewered population at each of the more important sources of pollution. All but 3,200 of the 20,300 people connected to sewers are served by sewage treatment plants.

TABLE St–3.—*Salt River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Stream	Miles above mouth of Salt River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Valley Station	Pond Creek	4			1,700	1,700
Fort Knox	Mill Creek	12	[1] 5,000	Secondary	5,000	800
Lebanon Junction	Rolling Fork tributary	23			12,000	12,000
Athertonville	Knob Creek	46			14,000	14,000
Bardstown	Beech Fork	54	1,500	None	14,800	14,800
Lebanon	Hardins Creek	81	3,500	Secondary	8,000	4,700
Springfield	Road Run	80	1,100	do	1,500	600
Gethsemane	Pottinger Creek	50			3,500	3,500
Dant	Pottinger Creek, South Fork.	55			1,500	1,500
Loretto	Hardins Creek, West Fork Prathers Creek.	70			1,400	1,400
Clermont	Lonelick Creek	26			20,000	20,000
Deatsville	Cane Run	47			16,000	16,000
Nazareth College	Cox's Creek	53	[2] 400	Secondary	2,500	2,200
Fairfield	Cox's Creek, East Fork	49			1,900	1,900
Taylorsville	Brashears Creek	57	800	None	1,100	1,100
Shelbyville	Clear Creek	88	3,200	Secondary	3,200	500
Lawrenceburg	Hammond Creek	96	1,500	do	7,700	6,400
Harrodsburg	Town Branch of Salt River.	123	1,700	Primary	1,800	1,200
6 smaller sources			1,600	Various	1,600	1,000
Total			20,300		119,200	105,300

[1] Conditions at time of survey in 1940. Population has since increased.
[2] Corrective measures being taken 1941. Figure represents conditions at time of survey.

Industrial wastes.—All of the 29 waste producing industrial plants in the basin have taken some steps to reduce the strength or amount of their wastes. Table St–4 shows data on the various sources of industrial wastes.

TABLE St–4.—*Salt River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlets		
Milk	2	1	1	2	700
Distilleries	24		24	24	97,500
Miscellaneous	1		1	1	
Waste, unconnected municipal treatment	27	1	26	27	98,200
Waste connected to municipal treatment					700
Total industrial waste in basin					98,900

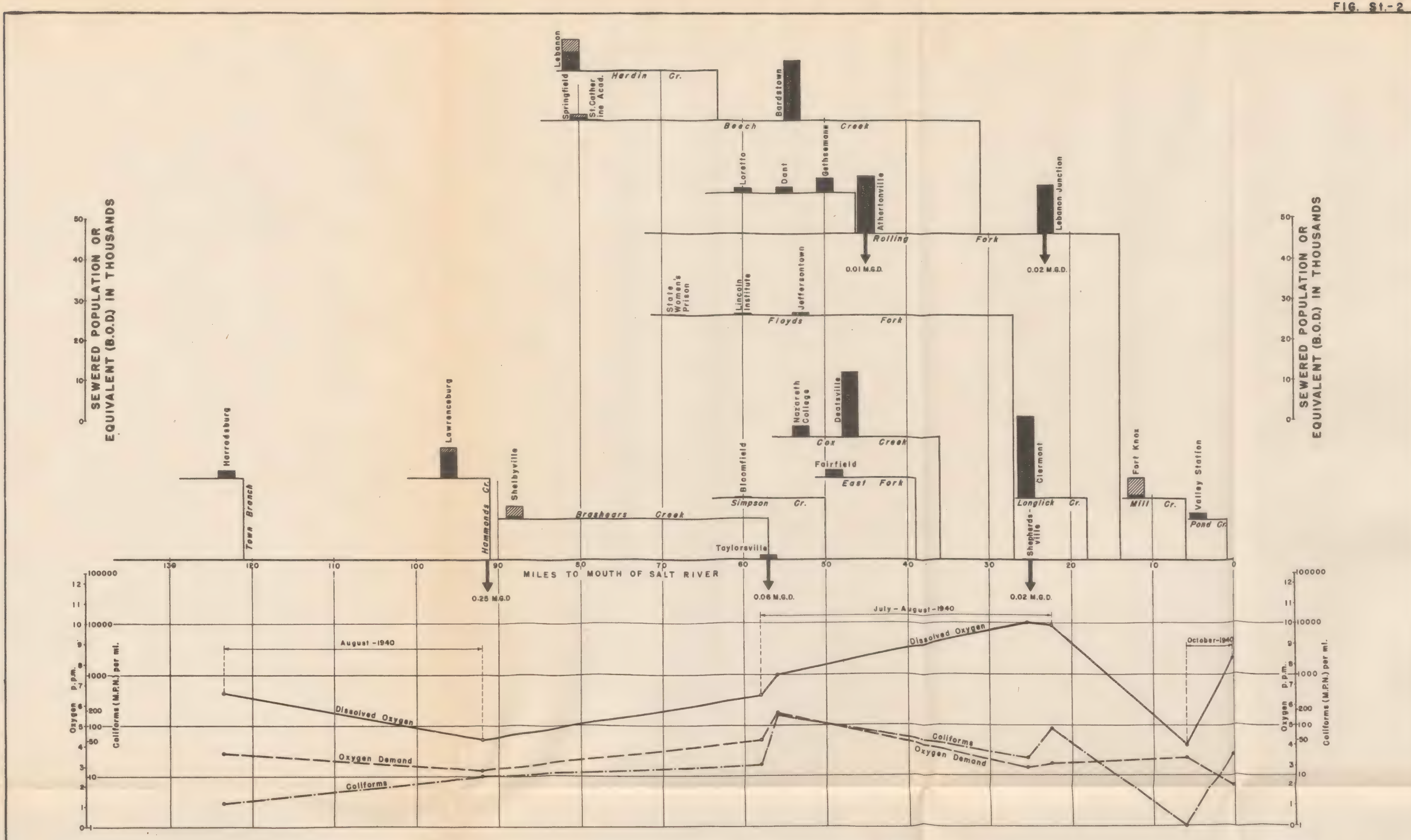


FIGURE-St 2
SALT RIVER
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

None of the distilleries operates throughout the year. Most of them commence operation in October or November and continue thoughout winter and spring. Since these are the months during which temperatures are low and stream flows high, the waste from the distilleries does not cause as serious pollution as if they operated throughout the summer months. Nevertheless they present the outstanding pollution problem of the basin.

Presentation of Laboratory Data

The laboratory results for the Salt River are presented in table St–7 (p. 718). Selected data on the main stream and on tributaries are shown in table St–5. The coliform, dissolved oxygen and oxygen demand results are shown graphically on the spot symbol maps in figures Ky–3, Ky–4, and Ky–5 (p. 676), respectively. These represent averages of from one to three samples taken over short periods and represent the most unfavorable picture from a series of several such observations at the mouth.

TABLE St–5.—*Salt River Basin: Selected laboratory data*

River / Location	Salt Above Harrodsburg	Salt Above Lawrenceburg	Salt Below Taylorsville	Salt Below Shepherdsville	Salt Above Mill Creek	Salt At Mouth	Town Branch Below Bridge Harrodsburg
River miles above mouth of Salt River.	123.5	92	56	22.5	6	0.1	122
Period, 1940	August	August	July–August	July–August	October	August	August
Number of samples	3	3	3	3	2	3	3
Flow in cubic feet per second:							
Sampling days	[1]	[1]	15	15	23	246	1
Minimum month	---	---	---	0.4	---	---	---
Water temperature °C	24.3	23.7	30.00	27.7	15.5	27.7	23.5
Coliforms per milliliter	3	10	161	88	[1]	845	45,000
Dissolved oxygen, parts per million	6.6	4.3	7.5	9.9	4.0	3.5	0.0
Biochemical oxygen demand, 5-day, parts per million	3.6	2.8	5.6	3.1	3.4	2.0	19.0

River	Hammond Creek	Rolling Fork	Rolling Fork	Road Run	Beech Fork	Hardins Creek	Mill Creek
Location	Below Lawrenceburg	At Lebanon Waterworks	At Boston	Below Springfield [2]	Below Bardstown [3]	Below Lebanon [2]	Below Fort Knox
River miles above:							
Confluence with Salt River	---	73.5	16.5	12	21	---	5
Mouth of Salt River	95	87.5	30.5	80	52	78.5	11
Period, 1940	August	August	August	August	August	August	August
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	[1]	2	87	[1]	25	[1]	1
Minimum month	---	---	16	---	---	---	---
Water temperature °C	21.3	22.0	24.0	25.5	23.8	20.7	24.5
Coliforms per milliliter	365	43	14	58,600	422	10,900	151
Dissolved oxygen, parts per million	2.6	5.0	6.3	0	5.8	2.6	2.8
Biochemical oxygen demand, 5-day, parts per million	7.9	1.6	1.9	104.0	2.2	13.0	9.0

[1] Less than 1 cubic foot per second.
[2] Miles above confluence with Beech Fork.
[3] Miles above confluence with Rolling Fork.

All observations in the Salt River Basin, except at the mouth, were made by a mobile laboratory unit during July and August 1940. Additional samples at the mouth and in the vicinity of Fort Knox were taken by a mobile unit in August and October of 1940 and February of 1941. At the time of this survey, there were practically no distillery wastes entering the streams, and stream flows were quite low.

From these laboratory data, it appears that the Salt River or its major tributaries are not seriously polluted except immediately below the larger sources of pollution. Lawrenceburg, Harrodsburg, Taylorsville, and Shelbyville appear to be the worst points affecting the main stem.

Springfield, Lebanon, and Bardstown on Beech Fork and its tributaries show bad local conditions below the towns. The Bardstown outfall sewer permits the discharged wastes to spread over the ground so that considerable recovery in dissolved oxygen and coliform reduction is probably achieved before the stream is reached.

High average coliform count of over 800 per milliliter and an average dissolved oxygen content of about three parts per million was found at the mouth of Salt River in August 1940. The effect of Fort Knox sewage is shown by the results at the mouth of Mill Creek.

The Salt River and its main tributaries seem to recover rather quickly from the pollutional loads placed upon them. The data show generally good coliform counts of 25 per milliliter or less above most towns on the larger streams, in contrast with fairly high counts below the towns next upstream. The dissolved oxygen generally is good with average values of 5 parts per million or more except immediately below sources of pollution. The average 5-day biochemical oxygen demand is generally less than 3 parts per million at the above stations and represents a considerable improvement over the values below the next upstream town.

Hydrometric Data

The only discharge record available in the basin prior to the beginning of this survey was on Beech Fork at Fredericktown, drainage area 530 square miles (11 miles above Bardstown), where a station was maintained from October 1930 to March 1932. During the first part of the record, zero flow prevailed and during the summer of 1931 the flow was less than 5 cubic feet per second for a considerable period. During 1940 and 1941 two stream-gaging stations have been maintained in connection with this survey, one on the Salt River at Shepherdsville (drainage area, 1,210 square miles) and one on Rolling Fork at Boston (drainage area, 1,300 square miles). During October 1940 the flow at Shepherdsville averaged 0.4 cubic feet per second and at Boston 16.0 cubic feet per second. As it is very brief, the entire record is presented on table St–6.

TABLE St–6.—*Salt River Basin: Monthly mean flows at gaging stations for years of record*

River	Salt	Rolling Fork	Beech Fork
Location	Shepherdsville	At Boston	At Fredericktown
River miles above—			
Confluence with Salt River		18	35
Mouth of Salt River	25	31	65
Drainage area (square miles)	1,210	1,300	530
Year	1940	1940	1930
July ... cubic feet per second	275	496	
August ... do	72	79	
September ... do	28	40	
October ... do	.4	16	0
November ... do	34	168	.1
December ... do	409	719	3.2
Year	1941	1941	1931
January ... cubic feet per second	1,233	1,088	114
February ... do	323	335	2,360
March ... do	304	330	4,820
April ... do			4,820
May ... do			325
June ... do			920
July ... do			510
August ... do			2,090
September ... do			2,360
October ... do			2,730
November ... do			4,300
December ... do			15,300
Year			1932
January ... cubic feet per second			17,900
February ... do			6,230
March ... do			13,100

Discussion

Sewage pollution in the Salt Basin is not a serious problem. Bardstown is the only urban community without a sewage-treatment plant, but local nuisances still exist at a few places. Three smaller communities and three small institutions either have no plants or very inadequate ones. At Harrodsburg the primary sewage-treatment plant appears inadequate. Enlargement and addition of secondary treatment devices are indicated. At the smaller places secondary treatment may be needed to prevent local nuisances.

The milk plants can all be connected to municipal treatment plants. The distilleries, however, are not readily accessible to city sewers, or discharge such large quantities of wastes that connection to municipal treatment plants is infeasible. Treatment facilities at a few of the distilleries are adequate at present, but at most of them some additional corrective measures appear justified. These would include evaporation of all objectionable wastes at the larger plants and improved broad irrigation at smaller plants. Disposal of slop to farmers and to cattle feed may be satisfactory at small plants and at normal times, but supplementary broad irrigation is needed for handling dilute wastes and emergency discharges. Broad irrigation must be located in rural areas and be carefully done to be reasonably effective. Ponding has not proved satisfactory even at small distilleries because of inadequate design and resulting overflows and breaks in dams, especially at times of heavy rains, and also because of the local nuisance created.

The estimated cost of these suggested remedial measures is summarized in table St–1.

TABLE St-7.—*Salt River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Salt River, above Harrodsburg, Ky	St 123.5	Aug. 13, 1940	(1)	25.0	8.3	98.7	5.3	4	8.2	15	110	94
Do	do	Aug. 16, 1940	(1)	27.0	5.6	69.6	2.1	2	7.7	20	102	
Do	do	Aug. 20, 1940	(1)	21.0	5.8	64.1	3.4	1	7.7	10	110	
Town Branch, 100 yards below sewer plant, Harrodsburg, Ky.	StTb 122	Aug. 13, 1940	1	25.0	0	0	15.0	46,000	7.3	20	224	210
Do	do	Aug. 16, 1940	1	25.5	0	0	19.0	43,000	7.3	20	234	
Do	do	Aug. 20, 1940	1	21.0	0	0	25.6	43,000	7.3	25	226	
Salt River, above Lawrenceburg, Ky	St 92	Aug. 13, 1940	2	25.5	4.5	53.7	3.2	4	7.7	30	138	114
Do	do	Aug. 16, 1940	2	25.0	5.9	70.0	2.2	2	7.7	25	124	
Do	do	Aug. 20, 1940	1	20.5	2.5	27.5	3.0	24	7.4	25	124	
Hammonds Creek, below Lawrenceburg, Ky.	StH 95	Aug. 13, 1940	(1)	23.0	2.0	23.0	11.8	910	7.5	50	228	214
Do	do	Aug. 16, 1940	(1)	23.0	2.3	26.8	5.6	91	7.4	55	240	
Do	do	Aug. 20, 1940	(1)	18.0	3.6	37.7	6.3	93	7.4	35	224	
Salt River, above waterworks, Taylorsville, Ky.	St 58	July 29, 1940	12	30.0	4.9	63.8	3.3	4	8.2	30	137	
Do	do	July 31, 1940	5	31.0	7.5	99.6	6.0	4	7.8	45	120	
Do	do	Aug. 2, 1940	4	28.5	7.1	90.6	3.8	43	8.1	75	128	128
Clear Creek waterworks intake, above Shelbyville, Ky.	StBC 89.5	July 29, 1940	(1)	30.0	2.6	34.3	8.5	4	7.6	45	113	
Do	do	July 31, 1940	(1)	26.0	2.7	34.0	11.4	46	7.5	40	152	
Do	do	Aug. 2, 1940	(1)	26.0	5.7	69.6	7.1	2	7.5	35	120	128
Clear Creek, disposal plant, Shelbyville, Ky, below.	StBC 84	July 29, 1940	(1)	30.0	0	0	15.8	36	7.3	5	123	
Do	do	July 31, 1940	(1)	28.0	7.1	90.2	8.8	4	7.7	50	124	
Do	do	Aug. 2, 1940	(1)	24.0	3.9	45.5	6.6	4	7.5	10	144	140
Brashears Creek, mouth, Taylorsville, Ky.	StB 58.5	July 29, 1940	12	30.0	8.7	114.5	7.1	11,000	7.8	70	151	
Do	do	July 31, 1940	7	30.0	4.7	61.1	8.4	91	7.6	65	148	
Do	do	Aug. 2, 1940	4	28.0	4.7	59.3	11.0	240	7.7	65	160	168
Salt River, 1½ miles below Taylorsville, Ky.	St 56	July 29, 1940	24	32.0	8.0	107.9	4.9	240	8.0	50	132	
Do	do	July 31, 1940	12	30.5	6.9	91.3	4.8	150	7.7	65	144	
Do	do	Aug. 2, 1940	8	27.5	7.6	94.9	7.2	93	8.0	75	146	148
Floyds Creek, mouth, near Shepherdsville, Ky.	StFf 28.5	July 30, 1940	6	29.0	4.6	59.2	4.4	36	7.7	50	148	
Do	do	Aug. 1, 1940	4	27.0	4.7	58.2	6.0	93	7.7	55	150	
Do	do	Aug. 5, 1940	2	27.0	5.9	73.6	3.6	43	7.8	50	152	180

Salt River, waterworks intake, above Shepherdsville, Ky.	St 25.5	July 30, 1940	24	30.0	9.8	129.1	2.9	9	7.7	10	112	----------
Do	do	Aug. 1, 1940	15	29.0	11.2	144.5	3.4	9	8.0	10	108	----------
Do	do	Aug. 5, 1940	5	28.0	8.8	111.7	2.4	46	7.7	20	116	116
Salt River, ¼ mile below Shepherdsville, Ky.	St 22.5	July 30, 1940	24	31.0	12.1	161.4	3.8	15	8.4	10	120	----------
Do	do	Aug. 1, 1940	15	26.0	9.4	114.7	3.2	240	7.8	30	106	----------
Do	do	Aug. 5, 1940	5	26.0	8.1	98.3	2.3	9	7.6	15	112	130
Rolling Fork, Lebanon waterworks, Calvary, Ky.	StRf 87.5	Aug. 14, 1940	2	25.0	4.2	50.6	1.9	46	7.5	120	94	94
Do	do	Aug. 19, 1940	2	21.0	5.7	63.4	.4	36	7.8	35	102	----------
Do	do	Aug. 21, 1940	1	20.0	4.9	53.4	2.6	46	7.7	45	104	----------
Rolling Fork, 1 mile below New Haven, Ky.	StRf 45.5	Aug. 12, 1940	50	27.5	6.1	76.1	1.6	43	7.7	70	118	116
Do	do	Aug. 15, 1940	18	23.5	5.9	68.7	1.4	2,400	7.5	50	108	----------
Do	do	Aug. 22, 1940	8	17.0	6.7	69.2	.8	23	7.6	35	120	----------
Road Run of Beech Fork, below Springfield, Ky.	StRfBfC 80	Aug. 13, 1940	(1)	28.5	0	0	119	110,000	7.2	200	172	142
Do	do	Aug. 16, 1940	(1)	29.0	0	0	80.6	43,000	7.3	100	188	----------
Do	do	Aug. 20, 1940	(1)	21.0	0	0	112	23,000	7.2	120	212	----------
Cartwrights Creek bridge, Route No. 68, Springfield, Ky.	StRfBfC 75	Aug. 13, 1940	2	26.5	10.3	126.5	6.5	46	8.4	110	100	98
Do	do	Aug. 16, 1940	(1)	30.0	10.9	142.6	3.6	9	8.4	45	100	----------
Do	do	Aug. 20, 1940	(1)	22.5	8.6	98.4	6.1	4	8.1	45	114	----------
Beech Fork, bridge, Route No. 68, Fredbrickstown, Ky.	StRfBfC 68	Aug. 13, 1940	10	27.0	7.2	89.0	4.4	9	8.2	65	124	110
Do	do	Aug. 16, 1940	5	30.0	6.7	87.7	1.9	9	7.8	65	120	----------
Do	do	Aug. 20, 1940	4	23.0	6.1	70.3	1.2	46	7.7	85	120	----------
Hardings Creek, below Lebanon, Ky	StRfBfH 78.5	Aug. 14, 1940	(1)	24.5	4.8	56.2	9.8	4,600	7.7	30	234	188
Do	do	Aug. 19, 1940	(1)	20.0	0	0	17.8	24,000	7.4	20	294	----------
Do	do	Aug. 21, 1940	(1)	17.5	3.1	32.2	11.3	4,300	7.7	10	294	----------
Mill Creek, 4 miles east of Bardstown, Ky.	StRfBfM 60	Aug. 13, 1940	(1)	26.5	9.7	118.8	2.2	46	8.4	15	134	142
Do	do	Aug. 16, 1940	(1)	31.0	9.8	130.6	2.0	23	8.3	10	144	----------
Do	do	Aug. 20, 1940	(1)	23.5	9.6	11.9	1.5	9	8.4	5	152	----------
BeechFork, 1 mile from Bardstown, Route No. 31 east.	StRfBf 52	Aug. 12, 1940	55	27.5	6.7	84.2	3.3	15	7.9	105	120	124
Do	do	Aug. 15, 1940	15	25.5	5.6	67.7	2.0	150	7.7	60	130	----------
Do	do	Aug. 22, 1940	6	18.5	4.9	52.2	1.4	1,100	7.6	110	134	----------
Rolling Fork, below Beech Fork, Boston, Ky.	StRf 30.5	Aug. 12, 1940	171	27.5	6.2	77.1	3.5	8	7.7	90	120	116
Do	do	Aug. 15, 1940	63	24.5	6.0	70.8	1.4	24	7.5	45	124	----------
Do	do	Aug. 22, 1940	28	20.0	6.8	74.3	.7	9	7.6	25	136	----------
Salt River, above Mill Creek	St 6.0	Oct. 25, 1940	----------	15.5	3.9	38.8	2.3	(1)	7.5	20	153	----------
Do	do	Oct. 26, 1940	----------	15.5	4.0	40.0	4.6	1	7.6	180	150	----------
Mill Creek, below Fort Knox	StM 11.0	Aug. 1, 1940	1	24.0	3.8	45.1	1.9	120	7.7	40	210	----------
Do	do	Aug. 5, 1940	2	24.0	1.8	21.1	17.8	93	7.7	35	264	220
Do	do	Aug. 6, 1940	1	25.5	2.9	34.9	7.4	240	7.7	40	258	----------

[1] Less than 1.

TABLE ST-7.—*Salt River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Pond Creek, above mouth	StP 1.0	Aug. 6, 1940		28.5	8.4	107.5	3.1	460	7.8	22	173	
Do	do	Aug. 8, 1940		28.5	5.1	65.6	2.6	1,100	7.7	44	164	128
Do	do	Aug. 12, 1940		27.5	8.7	108.8	3.6	9	7.8	23	160	
Do	do	Oct. 19, 1940		16.0	8.8	88.7	2.9	43	7.7	18	85	
Pond Creek, above mouth	StP 1	Oct. 21, 1940		15.5	8.0	80.1	2.2	110	7.5	15	71	
Do	do	Oct. 22, 1940		14.5	8.5	83.1	2.7	43	7.6	30	70	
Do	do	Oct. 23, 1940		15.5	8.0	80.1	2.8	23	7.6	20	68	
Do	do	Oct. 24, 1940		15.5	9.4	93.5	2.5	9	7.7	20	77	119
Do	do	Feb. 6, 1941		3.5	11.8	88.7	2.1	4	7.6	51	118	
Do	do	Feb. 7, 1941		2.0	11.8	85.1	2.6	4	7.7	40	120	130
Do	do	Feb. 8, 1941		0	12.5	85.4	4.3	15	7.6	410	129	
Do	do	Feb. 10, 1941		0	12.7	87.0	1.3	46	7.8	12	148	
Do	do	Feb. 11, 1941		0	12.7	86.7	1.0	1	7.7	15	160	
Salt River, at mouth	St 0.1	Aug. 6, 1940	99	28.5	3.7	47.6	2.3	2,400	7.5	23	130	
Do	do	Aug. 8, 1940	421	28.5	3.9	49.9	1.2	43	7.6	65	140	124
Do	do	Aug. 12, 1940	215	26.0	2.9	35.8	2.6	93	7.5	93	98	
Do	do	Oct. 19, 1940	22	17.0	8.6	88.2	2.1	15	7.7	18	74	
Do	do	Oct. 21, 1940	22	15.5	8.2	81.4	2.0	24	7.5	15	71	
Do	do	Oct. 22, 1940	22	15.0	8.5	83.5	2.2	43	7.5	18	63	
Do	do	Oct. 23, 1940	21	15.5	7.8	77.4	2.2	46	7.5	18	62	
Do	do	Oct. 24, 1940	24	16.0	8.7	87.2	2.2	9	7.7	18	67	114
Do	do	Feb. 6, 1941	949	4.0	12.7	96.9	1.1	39	7.7	18	163	
Do	do	Feb. 7, 1941	821	2.0	12.6	90.8	1.0	9	7.8	15	170	186
Do	do	Feb. 8, 1941	800	1.5	12.4	88.4	1.1	9	7.8	15	170	
Do	do	Feb. 10, 1941	614	2.5	12.7	93.2	1.2	9	7.8	10	174	
Do	do	Feb. 11, 1941	573	1.0	12.9	90.6	1.0	93	7.7	12	175	

WABASH RIVER BASIN

CONTENTS

	Page
Contents	723
Syllabus and conclusions	725
Description	726
Presentation of field data	727
Presentation of laboratory data	731
Hydrometric data	734
Discussion	737

LIST OF TABLES

W–1. Cost estimates of remedial measures	726
W–2. Surface water supplies	728
W–3. Sources of pollution	729
W–4. Industrial wastes	730
W–5. Selected laboratory data	732
W–6. Monthly mean summer flows	734
W–7. Summary of laboratory data	740

LIST OF FIGURES

W–1. Map—Sources of pollution	725
W–2a. Chart—Sources of pollution and selected laboratory data (lower Wabash)	730
W–2b. Chart—Sources of pollution and selected laboratory data (upper Wabash)	730
W–2c. Chart—Sources of pollution and selected laboratory data (West Fork White)	730
W–2d. Chart—Sources of pollution and selected laboratory data (East Fork White)	730
W–3. Map—Coliform results	732
W–4. Map—Dissolved oxygen results	732
W–5. Map—Biochemical oxygen demand results	732
W–6. Chart—Summer low-flow frequency curve	736

FIG. W-1

WABASH BASIN

SOURCES OF POLLUTION

(Face p. 725)

GPO-43 O-90035

FIG. W-1

WABASH RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Wabash River drains 33,100 square miles, almost one-sixth of the entire Ohio Basin. A little less than half of the 2,500,000 people in the basin are in urban communities. Indianapolis (386,972) and Terre Haute (62,693) are the largest cities. Agriculture is the predominant occupation and the principal industries are concerned with the processing of agricultural products. Coal, oil, and limestone are important mineral products.

Progress has been made toward the abatement of pollution and the sewage of almost three-quarters of the sewered population receives treatment. In spite of substantial progress toward the abatement of industrial pollution, these wastes cause the most serious problems at present.

CONCLUSIONS

(1) Forty-six of the 275 public water supplies in the basin are from surface sources. Thirty of these, serving 687,000 people, are from streams subject to pollution.

(2) About 1,120,000 persons are connected to sewers. The sewage of 73 percent receives treatment. Industrial wastes have a population equivalent of 1,772,000, of which 547,500 is discharged to municipal treatment plants.

(3) Laboratory studies indicate that the worst pollution problems are on the Wabash below Terre Haute, the West Fork of the White River below Indianapolis and the lower Muscatatuck River. In addition, many smaller streams are grossly polluted.

(4) The largest cities discharging untreated sewage are on the Wabash River. Partial treatment should be sufficient to maintain satisfactory conditions below Terre Haute and at other places on the Wabash from Logansport to the mouth.

(5) Secondary treatment will be required at most of the other communities such as Bedford, Columbus, and Shelbyville. Additional treatment facilities and interceptors are needed at Indianapolis and improvements or additions to existing plants are indicated for Danville, Ill., Franklin and Tipton, Ind. and other places.

(6) Canneries are the principal waste-producing industries. Most of these will require relatively complete treatment.

(7) Low-flow augmentation by proposed flood-control reservoirs on Raccoon Creek and on the Embarrass River would be of minor value in abating pollution at Terre Haute and Lawrenceville, respectively.

(8) A summary of cost estimates of remedial measures from table W–1 follows:

Treatment	Capital cost	Annual charges
Existing	$16,640,000	$1,600,000
Suggested additional	14,520,000	1,655,000

Estimated additional costs over existing charges of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	$11,050,000	$1,285,000
Secondary, all places	15,720,000	1,815,000

TABLE W-1.—*Wabash River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	10	74	822,000	$16,640,000	$1,020,000	$580,000	$1,600,000
Suggested minimum correction:							
Sewage-treatment plants	30	132	292,600	8,870,000	625,000	375,000	1,000,000
Required interceptors				3,960,000	185,000		185,000
Independent industrial waste correction				1,690,000	220,000	250,000	470,000
Total				14,520,000	1,030,000	625,000	1,655,000
Comparative cost:							
Primary treatment, all waste				11,050,000	785,000	500,000	1,285,000
Secondary treatment, all waste				15,720,000	1,115,000	700,000	1,815,000
As suggested				14,520,000	1,030,000	625,000	1,655,000

DESCRIPTION

The Wabash River drains 33,100 square miles in Illinois, Indiana, and Ohio. Almost three-quarters of the area is in Indiana, about one-quarter in Illinois, and less than 1 percent in Ohio. The northern and central parts of the area are flat or gently rolling but in the southern portion the land is quite hilly. The principal tributaries of the Wabash are:

Tributary	Distance above mouth of Wabash	Drainage area square miles	Tributary	Distance above mouth of Wabash	Drainage area square miles
Little Wabash River	15	3,380	Sugar Creek	245	840
Patoka River	95	850	Vermillion River	257	1,520
White River	96	11,290	Wildcat Creek	317	800
East Fork	147	5,680	Tippecanoe River	322	1,920
West Fork	147	5,430	Eel River	354	850
Embarrass River	122	2,350	Mississinewa River	375	890

The following tabulation of the population of some of the larger cities and of the entire basin shows the steady growth of most of the cities and the slow decrease in rural population until 1930. During the past 10 years the urban growth has been much slower and rural population has increased.

	Populations			
	1910	1920	1930	1940
Larger cities:				
Indianapolis, Ind	233, 560	314, 194	364, 161	386, 972
Terre Haute, Ind	58, 157	66, 083	62, 810	62, 693
Muncie, Ind	24, 005	36, 524	46, 548	49, 720
Anderson, Ind	22, 476	29, 767	39, 804	41, 572
Champaign-Urbana, Ill	20, 666	26, 117	33, 408	37, 366
Danville, Ill	27, 871	33, 776	36, 765	36, 919
Kokomo, Ind	17, 010	30, 067	32, 843	33, 795
Lafayette, Ind	20, 081	22, 486	26, 240	28, 798
Marion, Ind	19, 359	23, 747	24, 496	26, 767
Bloomington, Ind	8, 838	11, 595	18, 227	20, 870
Logansport, Ind	19, 050	21, 626	18, 508	20, 177
Vincennes, Ind	14, 895	17, 160	17, 564	18, 228
New Castle, Ind	9, 446	14, 458	14, 027	16, 620
Matton, Ill	11, 456	13, 552	14, 631	15, 827
Entire basin:				
Rural	1, 419, 832	1, 311, 126	1, 254, 967	1, 310, 468
Urban	811, 935	1, 006, 267	1, 117, 322	1, 198, 130
Total	2, 231, 767	2, 317, 393	2, 372, 289	2, 508, 598

The Wabash Basin is primarily an agricultural area and the principal industries are engaged in processing agricultural products (canneries, milk-processing plants, meat-packing plants, strawboard mills). There are an increasing number of machinery and metal products plants in the northern half of the basin. Coal is mined in the western part of the area in both Indiana and Illinois but production has been decreasing for some time. There are active oil fields in southern Illinois and in southwestern Indiana. The limestone quarries in the neighborhood of Bedford, Ind., furnish most of the fine-grained building and ornamental limestone in the country.

Water uses.—The Wabash River and its tributaries are not navigable for boats and barges of the size commonly used on the Ohio and its navigable tributaries. There are four hydroelectric power developments in the basin with an aggregate capacity of about 21,000 kilowatts. The two largest ones are on the Tippecanoe River, one near the mouth and the other a short distance above Monticello. The other developments, on the East Fork of White River at Williams and on the West Fork of White River at Noblesville, have capacities of about 3,200 and 500 kilowatts respectively. There are four known potential power sites, all of which would have small capacities totaling about 15,000 kilowatts.

The natural lakes in the northern part of the basin are used extensively for recreation as are the artificial lakes, particularly those at the power dams on the Tippecanoe River. There has been little commercial recreational development along the streams although they are used by local residents for fishing and swimming. There is some commercial fishing along the Wabash below New Harmony.

Presentation of Field Data

Figure W–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figures W–2a, W–2b, W–2c, and W–2d show similar data for four sections of the basin and, in addition, the location of water supply intakes from polluted streams and laboratory data on coliform organisms, dissolved oxygen, and biochemical oxygen demand. The pollution loadings shown represent the total of all sewage and industrial wastes in given communities.

Public water supplies.—Only 46 of the 275 public water supplies in the basin are taken from surface sources, but these serve more than 750,000 of the 1,300,000 served by all of the supplies. The underground water is generally hard and often contains objectionable amounts of iron but is usually of good enough quality to make it cheaper to use than surface water. Underground water is not generally available in large enough quantities to satisfy the needs of the larger cities.

Thirty of the surface-water supplies serving 687,500 people are from streams subject to pollution. Table W–2 shows data on these supplies. The Indianapolis supply, taken largely from the West Fork of White River, has until recently been polluted by untreated sewage from Muncie, Anderson, Elwood and a number of smaller towns. The recently installed sewage treatment plants at the three larger cities should do much to improve the quality of the raw water at Indianapolis. Princeton, Ind., is being forced to abandon its surface water supply from Patoka River on account of gross pollution by oil-field brines and acid mine drainage.

TABLE W–2.—*Wabash River Basin: Surface water supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls					
Mount Carmel	Illinois	Wabash River	95	FD	7,200	1.00
Vincennes	Indiana	do	128.2	FD	15,000	1.44
Terre Haute	do	do	215	FD	55,800	5.00
Carmi	Illinois	Little Wabash River	43	FD	3,400	.20
Fairfield	do	do	90	FD	2,800	.31
Flora	do	do	148	FD	4,000	.35
Louisville	do	do	160	FD	400	.03
Effingham	do	Little Wabash River, impounded.	196	FD	5,000	1.00
Mattoon	do	Little Wabash (impounded), wells.	226	LD	16,000	1.50
Princeton	Indiana	Patoka River	111	LD	7,700	.90
Winslow	do	do	144	FD	1,100	.07
Hazelton	do	White River	113	None	300	.01
Petersburg	do	do	143	FD	3,000	.44
Bedford	do	East Fork White River	241	FD	13,000	1.00
Mitchell	do	do	250	FD	2,400	.20
Seymour	do	do	315	FD	8,000	.82
Columbus	do	do	338	FD	6,000	2.20
West Baden	do	Lost River	215	FD	2,400	.24
Austin	do	Muscatatuck River	305	FD	1,500	2.00
North Vernon	do	North Fork Vernon Fork.	340	FD	3,200	.51
Washington	do	Wells, West Fork White River.	161	FD	8,800	1.00
Indianapolis	do	West Fork White River, Fall Creek, wells.	340	FD [3]	375,000	33.00
Anderson	do	West Fork White River.	390	FD	38,000	4.80
Muncie	do	West Fork White River, wells.	412	FD	43,000	3.80
Pendleton Reformatory	do	Fall Creek	367	FD	2,000	.60
Newton	Illinois	Embarrass River	188.5	FD	2,300	.24
Charleston	do	do	235	FD	8,000	1.70
Danville	do	North Fork Vermilion River.	278	FD	32,000	4.34
Logansport	Indiana	Eel River	355	FD	19,000	3.25
Montpelier	do	Salamonie River	437.5	FD	1,200	.07
Total:						
30 below sewer outfalls					687,500	72.02
16 other surface supplies					65,100	5.37
Total surface water supplies					752,600	77.39

[1] Miles above mouth of Wabash River.
[2] F=coagulated, settled, filtered: L=lime-soda softened; D=chlorinated.
[3] 2 filter plants, one with slow sand filters.

Sewerage.—Table W–3 shows the sewered population at some of the larger sources of pollution. About 73 percent of the sewered population of 1,119,700 is served by the 85 treatment plants in the basin. Secondary treatment predominates. The sewage from only 39,100 receives primary treatment, while that from 782,900 receives secondary treatment.

TABLE W–3.—*Wabash River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	State	Receiving stream	Miles above mouth of Wabash River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Mount Carmel	Illinois	Wabash River	95	6,000	None	65,000	65,000
Vincennes	Indiana	do	127	14,500	do	168,400	168,400
Terre Haute	do	do	215	26,000	do	373,400	373,400
Clinton	do	do	232	6,000	do	8,500	8,500
Attica	do	do	287	2,500	do	5,500	5,500
West Lafayette	do	do	312	13,000	do	13,000	13,000
Lafayette	do	do	312	26,000	do	32,400	32,400
Logansport	do	do	353	16,000	do	19,700	19,700
Wabash	do	do	388	6,500	do	19,500	19,500
Seymour	do	East Fork White River.	315	6,000	do	16,400	16,400
Columbus	do	do	338	9,000	do	32,600	32,600
Edinburg	do	Blue River	353	2,000	Secondary	17,000	15,300
Shelbyville	do	Blue River, Lewis Creek.	373	7,000	None	40,400	40,400
Carthage	do	Blue River	399	300	do	92,800	92,800
Knightstown	do	do	405	1,700	do	4,000	4,000
Martinsville	do	West Fork White River.	290	3,200	do	8,700	8,700
Indianapolis	do	do	332	370,000	Secondary	706,600	179,600
Noblesville	do	do	362	3,900	None	4,000	4,000
Anderson	do	do	387	37,500	Secondary	45,500	4,600
Muncie	do	do	406	40,000	do	46,000	10,700
Lawrenceville	Illinois	Embarrass River	131	2,000	None	15,000	15,000
Danville	do	Vermillion River	275	28,000	Chemical	34,200	9,800
North Manchester	Indiana	Eel River	400	3,100	None	3,900	3,900
South Whitley	do	do	413	900	do	5,400	5,400
Marion	do	Mississinewa River	408	19,500	Secondary	53,000	5,300
Gas City	do	do	415	3,000	None	4,800	4,800
Portland	do	Salamonie River	465	5,300	do	5,400	5,400
Mattoon [1]	Illinois	Little Wabash River-Kickapoo Creek-Riley Creek.	227	14,500	Secondary	17,300	10,800
Huntingburg	Indiana	Hunley Creek	180	3,000	None	3,700	3,700
Jasper	do	Patoka River	180	4,000	do	4,000	4,000
French Lick-West Baden.	do	Lost River	215	2,200	do	13,200	13,200
Bedford	do	Leatherwood Creek	246	11,300	do	11,300	11,300
Austin	do	Ditch to Muscatatuck River.	305	300	do	100,300	100,300
Scottsburg [2]	do	Stucker Fork	309	2,000	Primary	45,000	44,300
Brownstown	do	Ditch to East Fork White River.	300	300	None	23,100	23,100
Waldron	do	Conns Creek	374			8,600	8,600
Shirley	do	Six Mile Creek	409	400	None	18,700	18,700
Franklin	do	Youngs Creek	366	4,000	Secondary	41,000	16,700
Washington	do	Hawkins Creek	163	6,500	None	12,700	12,700
Plainville	do	Smothers Creek	185			33,000	33,000
Greenwood	do	Pleasant Run	324	1,500	None	19,500	19,500
Tipton	do	Cicero Creek	385	4,000	Secondary	18,500	10,600
Elwood [2]	do	Duck Creek	385	8,500	do	61,300	11,700
Alexandria	do	Pipe Creek	395	3,400	None	25,900	25,900
Robinson [2]	Illinois	Sugar Creek	170	3,000	Secondary	7,000	4,500
Kirklin	Indiana	Ditch to Sugar Creek	319	200	None	7,700	7,700
Champaign	Illinois	West Branch Salt Fork.	332	43,000	Secondary	43,000	4,400
Fowler	Indiana	Mud Pine Creek	317	1,200	None	5,300	5,300
Klondike	do	Indian Creek	310		do	6,000	6,000
Kempton	do	Swamp Creek	367			7,500	7,500
Kokomo	do	Wildcat Creek	371	31,500	Secondary	32,800	6,000
Rochester	do	Mill Creek	410	3,000	Primary	9,500	6,300

[1] Part of sewage treated.
[2] Plant not in operation at time of laboratory survey.

TABLE W-3.—*Wabash River Basin: Sources of pollution, including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*—Continued

Municipality	State	Receiving stream	Miles above mouth of Wabash River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
						Untreated	Discharged
Warsaw	Indiana	Walnut Creek	442	5,900	None	7,400	7,400
Columbia City	do	Blue River	426	4,000	do	8,500	8,500
Fowlerton	do	Ditch to Barren Creek	423			12,000	12,000
243 other sources				303,100		446,800	211,100
Total:							
Illinois				164,000		253,500	133,700
Indiana				949,300		2,608,500	1,681,800
Ohio				6,400		29,700	3,400
Total entire basin				1,119,700		2,891,700	1,818,900

Industrial wastes.—This type of pollution exceeds that from domestic sewage. Two hundred and fifty industrial plants, not connected to municipal treatment plants, discharge wastes with a sewered population equivalent of 1,224,500. About half of these plants are canneries. The canneries and the 12 paper plants (predominantly straw-board or straw-paper plants) account for about 80 percent of the industrial waste load not discharged to municipal treatment plants. Table W-4 summarizes data on industrial wastes by type of industry. Most of the industries make some attempt to reduce pollution but in the majority of instances additional treatment or recovery is needed.

TABLE W-4.—*Wabash River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent biochemical oxygen demand
		Municipal sewers	Private outlet		
Breweries	3	2	1	3	42,000
Canneries	123	26	97	121	530,000
Distilleries	2		2	2	121,000
Meat	31	6	25	30	36,100
Milk	45	25	20	34	11,900
Oil refineries	2	2		2	17,000
Paper	12	3	9	11	444,300
Steel	4		4	2	
Textiles	3	2	1		8,200
Miscellaneous	25	15	10	12	14,000
Waste unconnected municipal treatment	250	81	169	217	1,224,500
Waste discharged to municipal treatment					547,500
Total industrial waste in basin					1,772,000
By States:					
Illinois					89,500
Indiana					1,659,200
Ohio					23,300

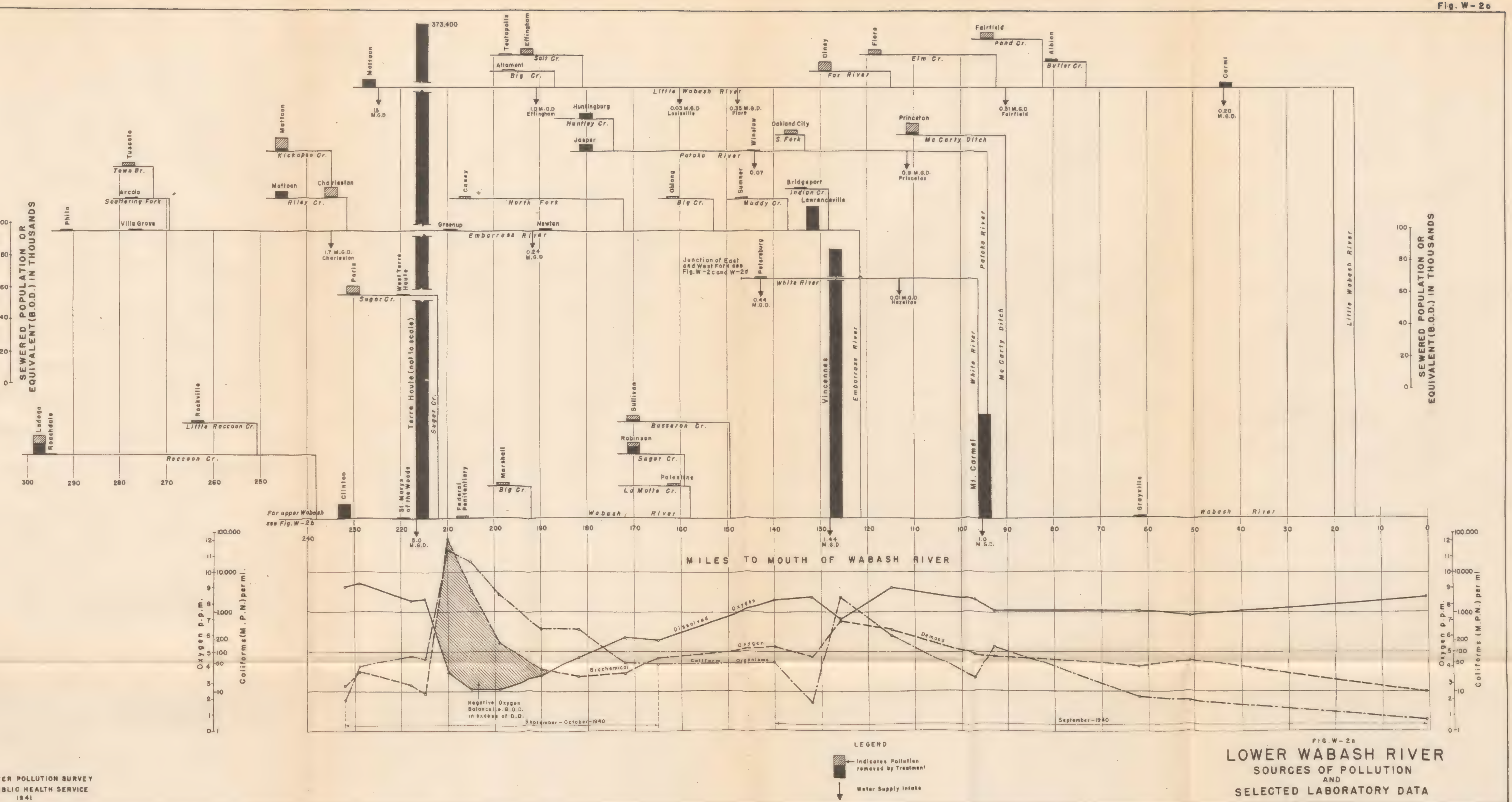


FIG. W-2a

LOWER WABASH RIVER

SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

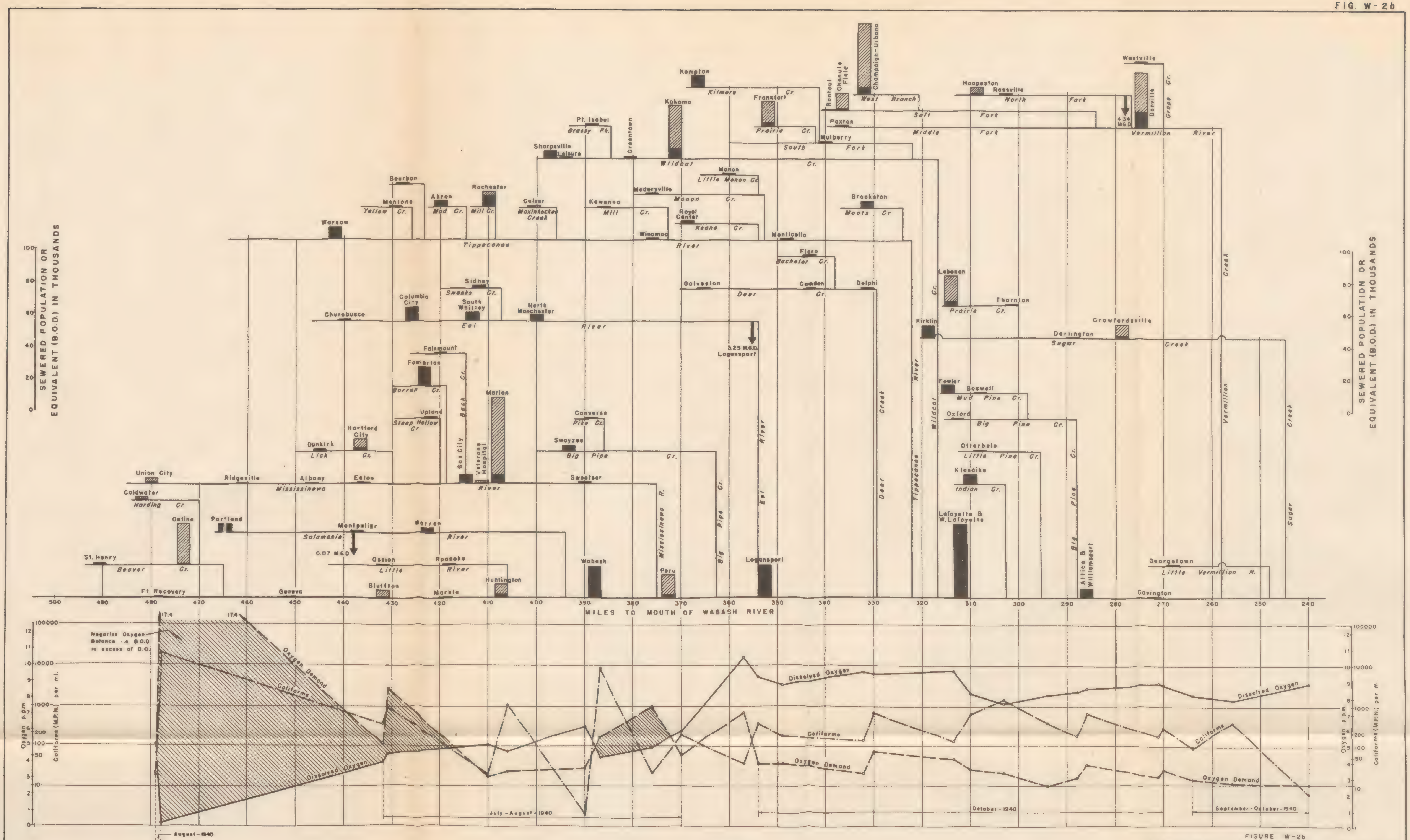


FIGURE W-2b

UPPER WABASH RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

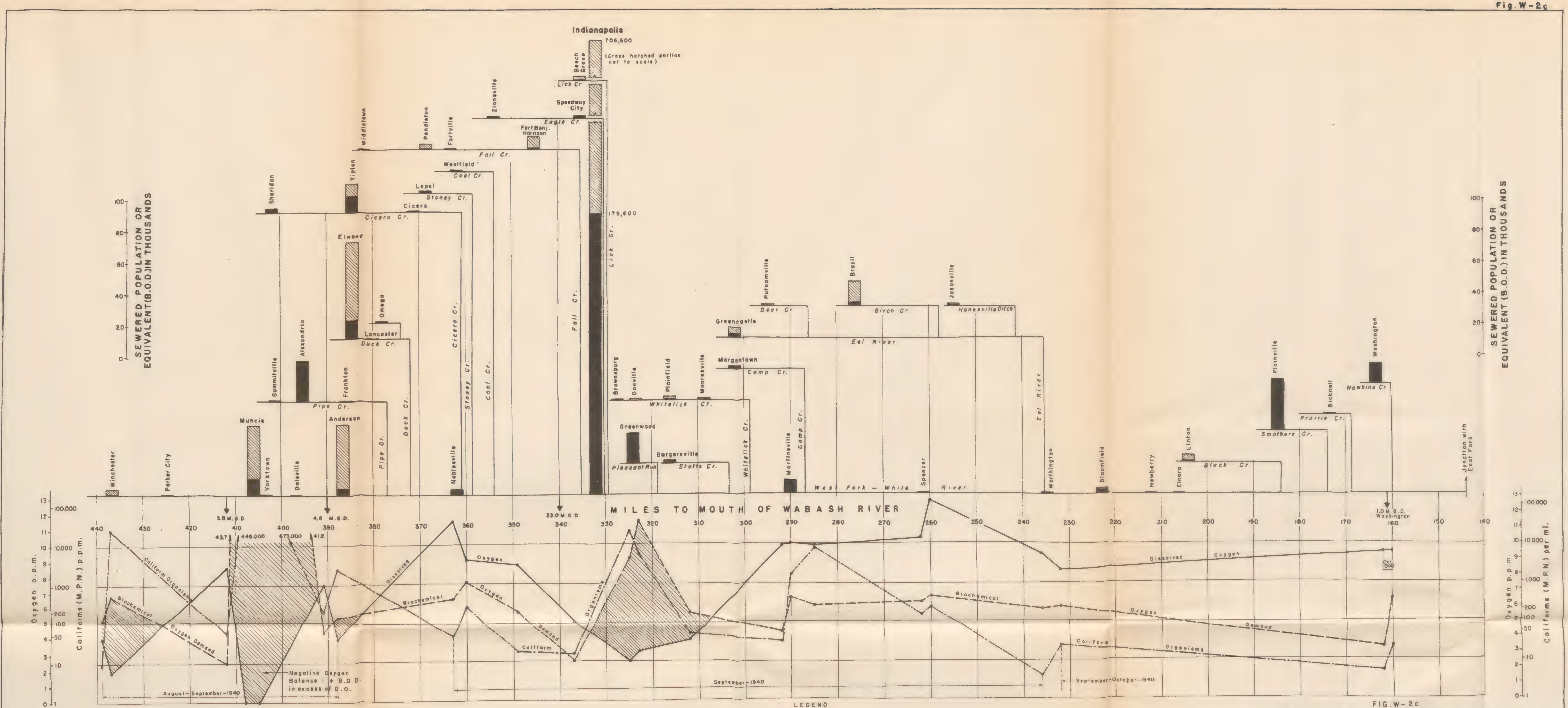
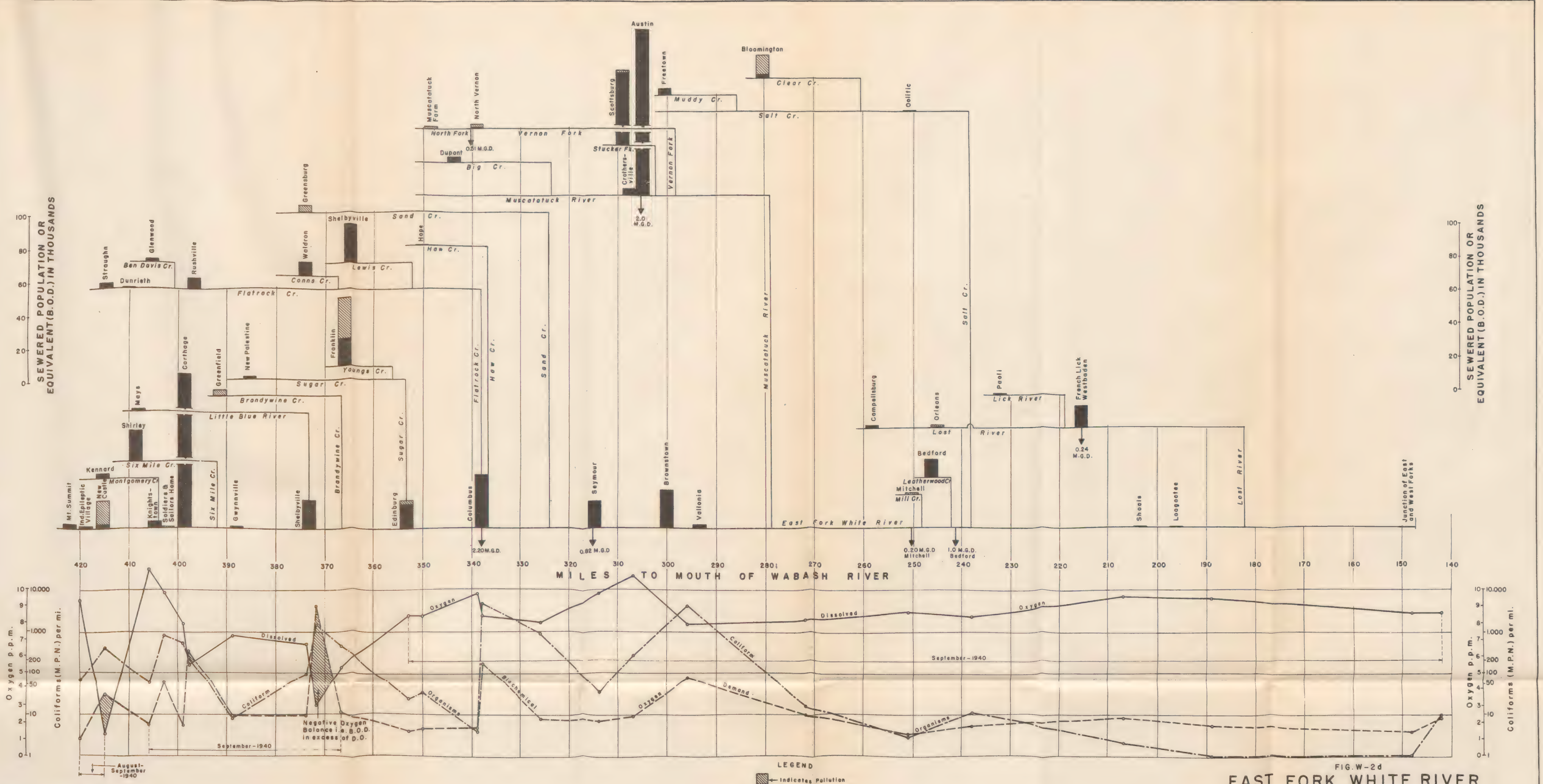


FIG. W-2c
WEST FORK-WHITE RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941



OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

FIG. W-2d
EAST FORK WHITE RIVER
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA

No differentiation has been made in the tables, maps, or charts between wastes which are discharged only seasonally and those which are discharged throughout the year. The pollution loadings shown represent conditions at the time of maximum seasonal operations. In the case of the canning industry this may occur only during a few weeks in the year but these few weeks are often during the late summer when the effects of organic pollution on the oxygen balance of the streams are most serious.

Acid mine drainage.—Mine waste has caused the greatest damage in the area drained by Patoka River. Prior to the inauguration of the mine-sealing program, about 110,000 tons of acid were discharged throughout the basin each year. The mine-sealing program has reduced this to about 63,000 tons per year.

Many of the mines in this area are strip mines. These have been sealed by damming the drainage outlet and flooding the acid-producing strata. A number of the lakes thus formed have been successfully stocked with fish and add to the recreational resources of the area.

Oil fields.—Wastes from oil fields do not at present cause a major pollution problem. Production in the older fields in both Illinois and Indiana is so small that even with relatively high brine-oil ratios the brine causes no particular problem in the larger streams. New activity in the old fields in Indiana has seriously affected the Patoka River and Princeton, Ind., is being forced to abandon its water supply from that stream. The new fields in both States have been developed since 1937 and new drilling is going on continuously. Most of the production is in the area drained by the Little Wabash River but there is considerable activity in fields near the Wabash and drained directly by it or by small tributaries. Brine production is small at present and none of the water supplies from the Little Wabash has as yet been damaged. The State Health Department of Illinois is taking steps to prevent the development of a serions problem. Where brine production is small, ponding with subsequent release during high water is practiced. Where there are appreciable quantities of brine it is being reinjected into subsurface formations which are unsuitable for use as sources of potable water.

Presentation of Laboratory Data

Laboratory results indicate that the major pollution problem in the basin is in the stretch of about 60 miles of the Wabash below Terre Haute. Poor sanitary conditions were also observed along the upper Wabash from Fort Recovery to below Bluffton, along the White River below Indianapolis, and along the Muscatatuck River. More or less localized pollution problems were found at Hartford City, Portland, Gas City, Columbia City, Warsaw, Kokomo, Frankfort, Rantoul, Danville, Mattoon, Flora, Albion, Muncie, Elwood, Franklin, and West Baden, with the worst conditions below Warsaw, Portland, Muncie, Hartford City, and West Baden. In general, the White River was found to be more heavily polluted than the Wabash but natural purification was more rapid along the White than along the Wabash.

Summaries of laboratory results are shown in table W–7 (p.740). Selected data appear in table W–5. The observations in this basin

were carried out by mobile laboratory units during the period July–November 1940, and during February 1941. From 1 to 12 samples were collected at each sampling point. Figures W–3, W–4, and W–5 show graphically the coliform, dissolved oxygen, and oxygen demand results, respectively. The data thus shown represent the average of all samples where observations were made for a period of less than 1 month. Where observations extended over several months the results shown are the most unfavorable monthly averages.

TABLE W–5.—*Wabash River Basin: Selected Laboratory data*

River	Wabash	Wabash	Wabash	Wabash	Wabash	Wabash	Wabash
Location	Above Fort Recovery, Ohio	Below Fort Recovery, Ohio	Above Logansport	Below Logansport	Above Lafayette	Below Lafayette	Above Terre Haute
River miles above mouth of Wabash.	479	478	357	354	313.5	303	215
Period, 1940	August	August	September–October	September–October	October	October	September–October
Number of samples	1	3	5	5	4	4	5
Flow in cubic feet per second:							
Sampling days	1	(1)	185	340	1,118	1,144	1,224
Minimum month	----	----	----	203	518	----	970
Water temperature, ° C	23.5	23.0	14.1	15.4	15.8	15.3	16.3
Coliforms per milliliter	21	20,000	37	354	128	1,330	60
Dissolved oxygen, parts per million	5.1	0.2	10.5	9.3	9.7	7.7	8.3
Biochemical oxygen demand, 5-day, parts per million	3.2	17.4	7.1	3.9	4.2	3.3	2.3

River	Wabash	Wabash	Wabash	Wabash	Wabash	Wabash	Wabash
Location	Above Terre Haute	Below Terre Haute	Above Vincennes	Below Vincennes	Above Mount Carmel	Below Mount Carmel	At mouth
River miles above mouth of Wabash.	210	199	152	126	97	93	0.5
Period, 1940	September–October	September–October	September	September	September	September	September
Number of samples	5	5	4	4	4	4	4
Flow in cubic feet per second:							
Sampling days	1,220	1,230	1,600	1,600	1,680	2,680	3,000
Minimum month	----	----	1,303	----	----	2,330	----
Water temperature, ° C	15.3	16.8	22.0	22.1	22.7	22.7	22.4
Coliforms per milliliter	34,000	2,400	5	2,160	19	130	2
Dissolved oxygen, parts per million	3.6	2.6	8.4	7.0	8.2	7.6	8.4
Biochemical oxygen demand, 5-day, parts per million	12.1	5.4	4.5	7.0	4.9	4.7	2.5

River	Salamonie	Salamonie	Little Lick Creek	Thorn Creek	Thorn Creek	Walnut Creek	Walnut Creek
Location	Above Portland	Below Portland	Below Hartford City	Above Columbia City	Below Columbia City	Above Warsaw	Below Warsaw
River miles above mouth of Wabash.	466	462	437	427	425	444	443
Period, 1940	August	August	August–September	July–August	July–August	July–August	July–August
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	(1)	4	1	7	7	2	5
Water temperature, ° C	22.5	22.3	22.8	21.7	22.8	26.5	24.3
Coliforms per milliliter	46	67,300	16,600	691	46,200	26	283,000
Dissolved oxygen, parts per million	6.2	0	0	4.7	.5	11.1	0
Biochemical oxygen demand, 5-day, parts per million	2.3	9.8	29.6	2.7	41.9	1.9	45.2

1 Less than 1.

FIG. W-3

WABASH BASIN

COLIFORM RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 732) No. 1 GPO-43 0-90035

FIG. W-3

FIG. W-4

WABASH BASIN

DISSOLVED OXYGEN RESULTS

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 732) No. 2 GPO-43 0-90035

FIG. W-4

FIG. W-5

WABASH BASIN

BIOCHEMICAL OXYGEN DEMAND

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 732) No. 3 GPO-43 O-90835

FIG. W-5

TABLE W-5.—*Wabash River Basin: Selected Laboratory data*—Continued

River	Wildcat Creek	Wildcat Creek	Prairie Creek	Salt Fork	Salt Fork	Vermillion	Vermillion
Location	Above Kokomo	Below Kokomo	Below Frankfort	Above Rantoul	Below Rantoul	Above Danville	Below Danville
River miles above mouth of Wabash.	373	371	349	339	338	277	273
Period, 1940	July	July	October	July-August	July-August	July-August	July-August
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	7	9	3	(1)	2	50	32
Minimum month							12.8
Water temperature, ° C	23.0	23.8	14.8	23.3	23.6	31.3	28.8
Coliforms per milliliter	14	4,680	88,100	148	2,340	18	39,400
Dissolved oxygen parts per million	4.3	1.0	2.4	7.6	2.3	7.7	2.7
Biochemical oxygen demand, 5-day, parts per million	4.6	3.9	22.2	1.4	12.5	2.1	13.4

River	Kickapoo Creek	West Fork-White	West Fork-White	West Fork-White	West Fork-White	Duck Creek	Youngs Creek
Location	Below Mattoon	Above Muncie	Below Muncie	Above Indianapolis	Below Indianapolis	Below Elwood	Below Franklin
River miles above mouth of Wabash.	244	412	405	349	325	382	364
Period, 1940	August	August-September	August-September	September	September	August-September	September
Number of samples	3	3	3	5	5	3	3
Flow in cubic feet per second:							
Sampling days	1	8	9	69	126	3	2
Minimum month		3.2			58.9		
Water temperature, ° C	22.8	22.7	20.0	18.7	25.8	19.8	17.0
Coliforms per milliliter	30,000	55	673,000	18	23,200	96,000	28,300
Dissolved oxygen parts per million	.4	8.7	0	8.7	2.9	.8	.2
Biochemical oxygen demand, 5-day, parts per million	25.0	2.5	41.2	5.7	9.1	40.3	113

River	Muscatatuck	Muscatatuck	Lost	Lost	Seminary Creek	Butler Creek
Location	Below Vernon Fork	Above mouth	Above West Baden	Below West Baden	Below Flora	Below Albion
River miles above mouth of Wabash	297	282	217	216	120	81
Period, 1940	October	October	October	October	August-September	August-September
Number of samples	3	6	3	3	3	3
Flow in cubic feet per second: Sampling days	5	6	6	7	(1)	(1)
Water temperature, ° C	12.8	15.3	13.7	15.0	19.5	19.0
Coliforms per milliliter	720	1	7	12,500	8,230	3,070
Dissolved oxygen parts per million	0	2.2	5.8	0	2.6	5.2
Biochemical oxygen demand, 5-day, parts per million	186.0	4.4	1.5	10.0	15.0	18.0

[1] Less than 1.

Stream flows were generally among the lowest of record during the period covered by this survey. In many instances, on the smaller streams, zero discharges made observations above towns impossible and minimum stages made general sample collections somewhat difficult.

Average coliform densities in excess of 400 per milliliter were observed in the Wabash for nearly 60 miles below Terre Haute in November 1940. Oxygen demands in excess of 12 parts per million and dissolved oxygen concentrations of less than 3 parts per million

were observed below the city. Reductions in oxygen demand appeared to be relatively rapid during the summer months but somewhat slower during cooler weather.

Coliform results on the Wabash showed slightly worse pollution than did the oxygen demand results but, in the main, were in close agreement as to the location of poor sanitary conditions. Little, if any, correlation appeared to exist between the dissolved oxygen results and the other observations, except in a few grossly polluted areas. This may have been due to photosynthesis or to low water temperatures. Considerable natural purification appears to have been effected at fairly rapid rates below sources of pollution.

A few acid stream samples were taken in the Patoka River area along the South Fork ditch and in the vicinity of Patoka. pH values ranged from 3.4 to 4.7 and phenolphthalein acidities of over 500 parts per million were found.

At its mouth the Wabash River was found to be in good sanitary condition.

Biological summary.—The plankton population of the Wabash and the larger tributaries is the highest in the entire Ohio Basin—the total volumes often reaching 12,000 to 14,000 parts per million and in a few cases as high as 75,000 parts per million. These high values are due to the increase in the available plant food as a result of the decomposition of the sewage from the heavily populated centers. The fertility of the stream is also reflected in the large mixed fish population.

Hydrometric Data

Forty-eight stream-gaging stations have been maintained in the basin for various periods and 35 stations are currently in operation. Table W–6 shows mean monthly flows at 24 of these stations during some of the driest summers of record.

TABLE W–6.—*Wabash River Basin: Monthly mean summer flows for years in which lowest summer flows have occurred*

River	Wabash	Wabash	Wabash	Wabash	Wabash	Mississinewa	Eel
Location	Bluffton, Ind.	Wabash, Ind.	Logansport, Ind.	Terre Haute, Ind.	Mount Carmel, Ill.	Marion, Ind.	North Manchester, Ind.
River miles above—							
Confluence with Wabash						33	46
Mouth of Wabash	421.8	387.7	353.9	214.4	91.5	408	400
Drainage area (square miles)	470	1,670	3,760	12,200	28,600	740	429
Period of record	1923–40	1923–40	1903–06 1923–40	1905–06 1928–40	1928–40	1924–40	1924–40
Year	1936	1940	1940	1936	1936	1940	1928
June, cubic feet per second	23.9	856	1,810	2,960	5,760	279	195
July, do	39.0	164	511	970	3,220	56.3	229
August, do	9.09	57.1	241	1,240	2,330	25.0	61.8
September, do	8.63	44.0	203	2,640	3,810	21.0	37.9
Year	1935	1932	1939	1940	1940	1928	1940
June, cubic feet per second	78.5	363	1,450	8,154	15,115	1,170	229
July, do	131	327	1,156	2,444	5,570	316	89.6
August, do	47.7	45.9	699	1,183	2,890	50.5	44.4
September, do	9.03	291	233	1,062	2,450	24.8	50.6
Year	1939	1934	1936	1934	1930	1936	1930
June, cubic feet per second	172	128	595	1,440	6,050	65	87.9
July, do	100	55.4	269	1,380	4,110	32.6	45
August, do	46.4	207	374	3,140	3,280	31.7	130
September, do	9.62	132	525	3,450	3,670	43.4	61.7

TABLE W-6.—*Wabash River Basin: Monthly mean summer flows for years which lowest summer flows have occurred*—Continued

River	Tippecanoe	Vermilion	Embarrass	Patoka	Little Wabash	West Fork White	West Fork White
Location	Monticello, Ind.	Danville, Ill.	Ste. Marie, Ill.	Patoka, Ind.	Wilcox, Ill.	Muncie, Ind.	Anderson, Ind.
River miles above—							
Confluence with Wabash	28	19	53	12	119	316	294
Mouth of Wabash	350	276	175	107	134	412	390
Drainage area (square miles)	1,740	1,280	1,540	843	1,130	259	412
Period of record	1924–40 (1)	1915–21 1928–39	1910–12 1914–39	1935–40	1914–39	1924–29 1931–40	1925–27 1932–40
Year	1934	1920	1914	1936	1930	1940	1940
June, cubic feet per second	303	252	----------	7.93	20.6	117	226
July, do	180	54.0	----------	18.9	9.75	16.7	51.3
August, do	489	54.2	----------	3.58	4.26	4.8	5.1
September, do	1,007	14.4	13.5	9.90	372	3.2	20.9
Year	1940	1930	1922	1940	1936	1932	1936
June, cubic feet per second	1,027	165	364	146	19.0	109	76.6
July, do	429	67.9	257	71.4	30.0	30.9	37.9
August, do	237	17.9	52.2	11.3	4.44	7.18	34.8
September, do	240	35.7	26.3	24.4	7.26	94.5	33.8
Year	1936	1919	1930	1939	1922	1939	1934
June, cubic feet per second	624	576	155	571	100	92.8	93.4
July, do	246	130	80.3	223	121	53.6	50.5
August, do	298	43.8	27.9	318	12.4	27.9	37.3
September, do	406	20.7	137	20.1	5.37	9.34	44.0

River	West Fork White	West Fork White	Fall Creek	East Fork White	East Fork White	Flat Rock Creek	Muscatatuck
Location	Noblesville, Ind.	Indianapolis, Ind.	Millersville, Ind.	Seymour Ind.	Shoals, Ind.	St. Paul, Ind.	Austin, Ind.
River miles above—							
Confluence with Wabash	274	236	247	218	107	275	212
Mouth of Wabash	370	332	343	314	203	371	308
Drainage area, square miles	819	1,620	327	2,340	4,940	303	368
Period of record	1924–40	1904–06 1925–40	1925–26 1930–40	1923–40	1903–05 1908–16 1923–40	1925, 1931–40	1932–40
Year	1940	1940	1940	1925	1911	1934	1936
June, cubic feet per second	366	752	117	827	228	19.7	6.93
July, do	104	160	36.8	867	117	13.1	3.37
August, do	69.5	71.1	19.7	282	95.8	6.75	1.48
September, do	58.7	58.9	17.0	122	1,640	4.92	----------
Year	1936	1936	1936	1927	1936	1936	1940
June, cubic feet per second	167	302	72.2	826	696	29.4	155
July, do	80.3	90.3	29.1	149	489	9.28	14.6
August, do	65.8	79.4	19.6	157	265	14.6	2.1
September, do	69.1	105	22.3	135	379	84.3	2.6
Year	1932	1939	1934	1936	1940	1940	1933
June, cubic feet per second	380	651	42.2	448	2,079	208	47.6
July, do	190	683	38.4	231	763	31.5	7.8
August, do	89.2	413	25.1	169	373	12.2	23.7
September, do	265	124	34.7	227	311	9.8	42.6

[1] From 1924–31 the station was at Pulaski, 32 miles upstream, drainage area 1,110 square miles. None of the flows at this station were as low as those at Monticello from 1932–40.

Fig. W-6

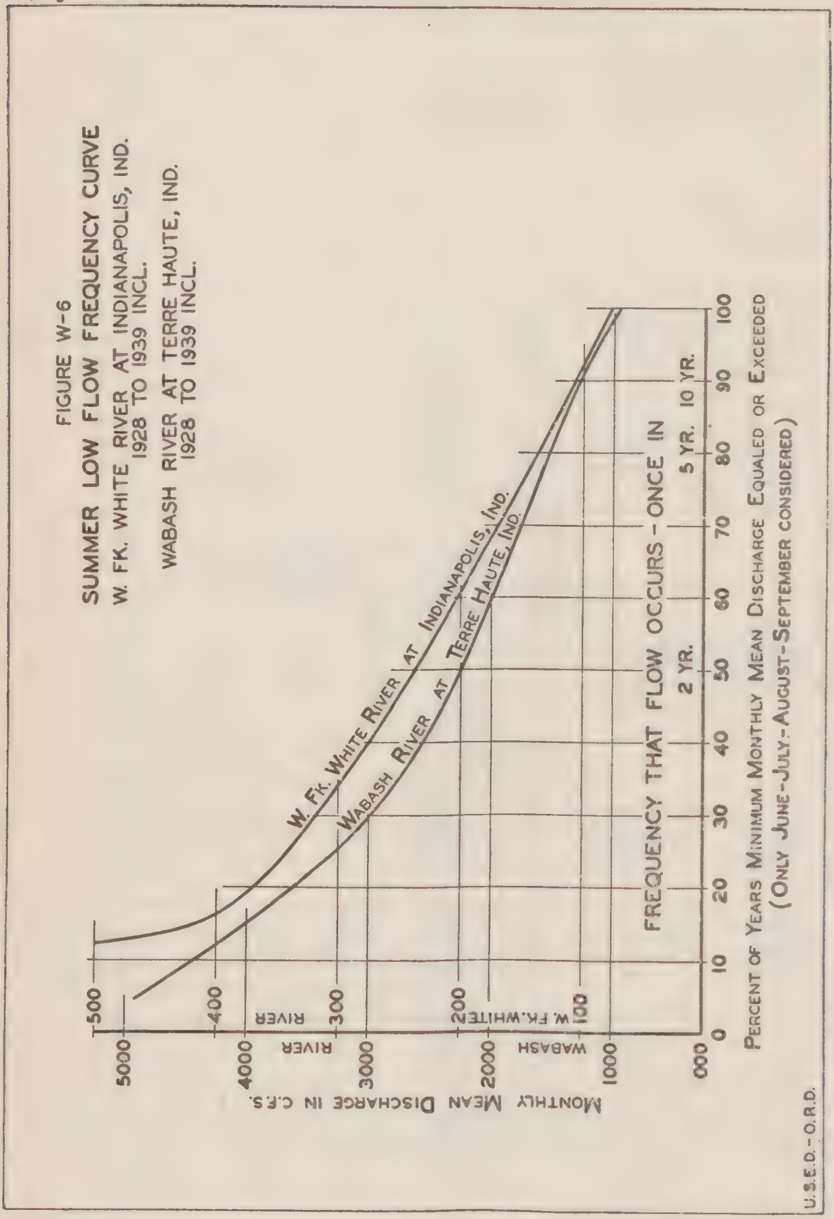


FIGURE W-6
SUMMER LOW FLOW FREQUENCY CURVE
W. FK. WHITE RIVER AT INDIANAPOLIS, IND.
1928 TO 1939 INCL.
WABASH RIVER AT TERRE HAUTE, IND.
1928 TO 1939 INCL.
W. FK. WHITE RIVER AT INDIANAPOLIS, IND.
WABASH RIVER AT TERRE HAUTE, IND.
FREQUENCY THAT FLOW OCCURS - ONCE IN
2 YR.
5 YR.
10 YR.
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF YEARS MINIMUM MONTHLY MEAN DISCHARGE EQUALED OR EXCEEDED
(ONLY JUNE-JULY-AUGUST-SEPTEMBER CONSIDERED)
500
400
300
200
100
W. FK. WHITE RIVER
5000
4000
3000
2000
1000
000
WABASH RIVER
MONTHLY MEAN DISCHARGE IN C.F.S.
U.S.E.D. - O.R.D.

Proposed stream control.—Five flood-control reservoir sites have been studied by the United States Engineer Department for construction under the authorized program for Ohio River flood control. Data on these reservoirs are tabulated below:

Reservoir	Stream	Miles above mouth of Wabash River
Mansfield	Raccoon Creek	259
Wolf Creek	Embarrass River	190
Cagles Mill	Mill Creek	285
Spencer	West Fork White	265
Shoals	East Fork White	208

There are no large sources of pollution along the streams below the latter three of these reservoirs with the exception of Mount Carmel on the Wabash. Although there are no important sources of pollution on Raccoon Creek, below the Mansfield Reservoir site, any additional flow made available by the reservoir by using a portion of the flood-control capacity for low-flow regulation after the end of the flood season would be of value for pollution abatement at Terre Haute. Wastes from Lawrenceville are discharged to the Embarrass River below the Wolf Creek site and additional flow from the reservoir would be of value at that point. The value to pollution abatement of low-flow regulation from these reservoirs would not be great enough to warrant provision of additional storage capacity expressly for this purpose.

Discussion

While commendable progress, in general, has been made in sewage treatment, untreated sewage from a number of cities and towns seriously affects the water supplies of downstream communities. The heaviest remaining pollution results from the discharge of untreated or inadequately treated industrial wastes.

At Terre Haute, the largest source of pollution in the basin, industrial wastes have a population equivalent of more than 12 times the sewered population. At some of the other communities where large canneries are located the ratio is even higher. A number of sewage-treatment plants are successfully treating industrial waste loads that are considerably greater than the strictly domestic sewage load.

Wabash River.—The four largest cities without sewage treatment works (Terre Haute, Vincennes, La Fayette, and Logansport) are all on the Wabash River. The flow in the river at these and at other communities on the main stream below Logansport is ample to permit the satisfactory disposal of sewage and most industrial wastes with only partial treatment.

The major part of the waste load at Terre Haute comes from strawboard plants and distilleries. Canneries, packing houses, and a few other industries add to the industrial waste load. Although the city has a population of 62,000 only about 26,000 are served by the municipal sewerage system. Much of the industrial waste can be treated effectively at a municipal plant. Pretreatment at the industrial plant before discharge to city sewers is indicated in a few cases. The strawboard wastes here and also at Vincennes probably will require separate treatment.

Secondary sewage treatment is indicated at Wabash, the only town of appreciable size on the Wabash River above Logansport not now having such facilities.

East Fork of White River.—Untreated sewage from a number of communities along the East Fork and its tributaries causes damage of more than local importance. The larger communities are Bedford, Columbus, Shelbyville, and Seymour. Secondary treatment is indicated at the first three. Primary treatment should be sufficient at Seymour. Large amounts of untreated or inadequately treated industrial wastes, principally from canneries and a strawboard plant, contribute a much larger oxygen demand than the domestic sewage.

Four public water supplies are taken from the East Fork (see table W–2) and the untreated water at all of these has been found occasionally to be rather heavily polluted, although at the time of the laboratory survey the bacterial counts were not unduly high. Evidence of the need for improved waste treatment in this area is shown by the epidemics of gastroenteritis, evidently water-borne, which occurred early in February 1940, in the towns using the East Fork as a source of public water supply. Seymour was particularly hard hit, about one-quarter of the people using the public supply being affected. Those not using the public supply were not affected nor did communities using other sources of supply experience any similar outbreaks. The epidemics occurred with a rise in the river following a continued period of low flow during which the stream was covered with ice. These factors all indicate that the probable cause of the disorders was undue pollution of the stream by sewage and industrial wastes at a time when natural purification processes were least rapid.

Two large canneries, at Scottsburg and Austin, cause serious oxygen depletion of the Muscatatuck River for more than 25 miles. At the time of the laboratory survey the average dissolved oxygen content was found to be only 2.2 parts per million at the mouth of the stream and at other times the entire Muscatatuck River has been septic due to these wastes. The communities at which these canneries are located are small and the industrial wastes will need to be treated separately. Relatively complete treatment is indicated.

West Fork of White River.—At Indianapolis the sewage flow is approaching the design capacity of the treatment plant built in 1925. Expansion of some of the units is necessary if the plant is to produce a satisfactory effluent. A number of the existing interceptors flow almost full during dry weather and even light rains cause overflows of untreated wastes into Fall Creek and the West Fork with attendant nuisance conditions. Larger or additional interceptors are indicated.

The larger cities and industries above Indianapolis water supply intake on the West Fork have taken steps to abate pollution. Sewage from Noblesville, however, still enters the stream without treatment. The provision of at least primary treatment and chlorination is indicated for the further protection of Indianapolis' water supply. Secondary treatment of sewage and industrial wastes at Alexandria is indicated. These wastes cause a serious local nuisance in Pipe Creek which enters the West Fork above Indianapolis. Complete treatment of sewage and cannery wastes at Pendleton and improvements to the existing treatment plant at the Pendleton Reformatory are needed to protect the quality of Fall Creek which is also used by Indianapolis as a source of public water supply.

Other sources of pollution.—Existing sewage-treatment plants at a number of cities need improvements or additions; among these are Danville, Ill., Sullivan, Franklin, Tipton, and Greencastle, Ind. The majority of the communities now discharging untreated sewage are on small streams subject to extremely low flows. Secondary treatment is essential at these places to prevent local nuisances; Warsaw, Columbia City, Gas City, Huntingburg, Jasper, Portland, and Washington, Ind., are examples of such communities.

A large part of the industrial waste load can be most easily and satisfactorily handled at municipal treatment plants. Wastes from many of the canneries and some of the other industries will require separate treatment. Small and moderate-sized canneries which operate only seasonally can often dispose of their wastes without nuisance to lagoons or by broad irrigation if care is taken to prevent accidental discharges of wastes to the streams. Detailed study of some plants will be necessary to determine the most practicable method of handling the wastes. Several sewage-treatment plants, notably those at Muncie, Crawfordsville, and New Castle, Ind., have experienced operating difficulties because of acid pickle liquors discharged to the municipal sewers by metal-processing plants. Either separate treatment or pretreatment of such wastes at the industrial plant seems necessary to prevent interference of these wastes with treatment processes.

Continuation of the work of the Illinois State Health Department on disposal of oil field wastes appears necessary. As the field becomes older and brine production increases, the water supplies taken from the Little Wabash River would be affected if present rigid methods of disposal were not continued. Resumption of the mine-sealing program is desirable, particularly in Indiana.

Flow regulation by the proposed flood-control reservoirs on Raccoon Creek and the Embarrass River could be of value in abating pollution at Terre Haute and Lawrenceville. In neither case would the value to pollution abatement be large enough to have any appreciable influence on the economic justification of the project, nor would the provision of additional storage capacity solely for the purpose of pollution abatement be economically justified.

Estimated costs of existing treatment and of the suggested program of municipal and industrial waste treatment facilities are summarized in table W–1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Wabash River, above Fort Recovery, Ohio.	W 479	Aug. 29, 1940	1	23.5	5.1	59.2	3.2	21	7.8	60	180	
Wabash River, below Fort Recovery, Ohio.	W 478	Aug. 15, 1940	(1)	27.5	.8	9.5	12.7	4,600	7.7	30	278	280
Do	do	Aug. 22, 1940	(1)	18.5	0	0	26.7	46,000	7.8	50	208	
Do	do	Aug. 29, 1940	1	23.0	0	0	12.9	9,300	7.7	40	216	
Beaver Creek, above Celina, Ohio	WBe 474	Aug. 15, 1940	7	25.5	7.6	91.6	5.3	23	7.8	130	90	130
Do	do	Aug. 22, 1940	8	23.0	7.3	83.9	7.5	4	8.4	130	82	
Do	do	Aug. 29, 1940	8	24.5	7.0	82.8	6.1	9	8.2	110	86	
Beaver Creek, ½ mile below Celina, Ohio.	WBe 473	Aug. 15, 1940	10	26.0	2.4	29.0	5.1	93	7.5	85	108	190
Do	do	Aug. 22, 1940	12	22.5	2.0	22.6	5.8	1,100	7.6	70	97	
Do	do	Aug. 29, 1940	11	23.5	.9	10.3	8.1	2,400	7.5	65	112	
Herondon Creek, ½ mile below Coldwater, Ohio.	WBeHe 476	Aug. 15, 1940	(1)	23.5	3.2	37.7	3.1	240	7.7	25	279	440
Do	do	Aug. 22, 1940	(1)	17.5	2.3	24.3	6.2	460	7.6	35	279	
Do	do	Aug. 29, 1940	(1)	22.5	1.6	17.8	6.4	2,400	7.7	80	301	
Wabash River, above Bluffton, Ind	W 432	July 19, 1940	20	26.0	6.5	79.3	5.7	43	7.9	270	182	288
Do	do	July 29, 1940	16	28.0	4.2	52.5	4.7	7	8.0	180	208	
Do	do	Aug. 6, 1940	29	26.5	1.5	19.7	5.0	1,100	7.2	450	93	
Wabash River, below Bluffton, Ind	W 431	July 19, 1940	20		6.9		4.4	93	8.1	170	194	300
Do	do	July 29, 1940	17	29.0	4.0	51.0	3.6	460	7.8	150	228	
Do	do	Aug. 6, 1940	30	26.5	2.7	33.4	17.8	2,400	7.2	150	144	
Wabash River, above Huntington, Ind.	W 410	July 26, 1940	26	31.5	5.3	71.5	4.4	23	8.1	110	207	296
Do	do	Aug. 5, 1940	10	25.0	5.3	63.4	1.9	12	8.0	120	224	
Do	do	Aug. 13, 1940	20	25.0	4.7	55.8	3.0	24	8.0	110	208	
Do	do	Nov. 5, 1940	32	12.5	9.2	85.5	2.3	4	7.9	35	214	
Do	do	Nov. 12, 1940	68	3.0	11.1	82.5	2.3	46	7.9	40	218	
Do	do	Nov. 18, 1940	26	4.0	13.2	100.5	2.3	4	7.8	12	227	
Do	do	Nov. 25, 1940	18	3.5	12.1	91.2	1.2	4	8.0	12	220	
Little River, above Huntington, Ind	WLr 409	July 26, 1940	2	27.0	6.9	85.0	3.0	23	8.1	110	282	284
Do	do	Aug. 5, 1940		22.0	6.1	69.3	2.1	4	7.9	110	278	
Do	do	Aug. 13, 1940	4	25.5	6.5	78.7	1.8	4	8.0	55	280	
Do	do	Nov. 5, 1940	5	12.0	9.4	86.8	1.6	9	7.8	50	264	
Do	do	Nov. 12, 1940	20	3.0	9.7	72.0	3.1	460	7.8	250	207	
Do	do	Nov. 18, 1940	5	5.0	13.4	104.5	.9	9	7.7	15	272	
Do	do	Nov. 25, 1940	5	5.5	12.0	95.2	1.1	4	7.8	35	284	

Little River, below Huntington, Ind.	*WLr 407*	*Aug. 5, 1940*	*2*	*27.0*	*3.9*	*48.2*	*6.5*	*11,000*	*7.8*	*10*	*270*	----------
Do	do	Aug. 9, 1940	----------	25.5	12.0	144.3	4.9	240	8.4	5	277	384
Do	do	Aug. 13, 1940	5	25.5	4.0	48.4	4.2	1,100	7.8	7	288	----------
Wabash River, below Huntington, Ind.	W 406	July 26, 1940	53	29.5	5.0	64.4	3.2	240	8.0	60	231	268
Do	do	Aug. 5, 1940	26	27.0	5.1	63.2	3.5	2,400	8.0	80	236	----------
Do	do	Aug. 13, 1940	25	27.0	4.0	49.3	3.3	460	7.8	45	232	----------
Do	do	Nov. 5, 1940	38	12.5	5.8	54.5	5.8	1,100	7.7	20	224	----------
Do	do	Nov. 12, 1940	102	2.0	10.8	78.1	4.4	460	7.9	50	238	----------
Do	do	Nov. 18, 1940	33	4.5	13.0	99.8	2.1	460	7.8	12	233	----------
Do	do	Nov. 25, 1940	30	4.5	11.4	88.0	1.7	1,100	8.0	12	243	----------
Salimonie River, 1½ miles above Portland, Ind.	WSa 466	Aug 16, 1940.	(1)	25.0	5.5	65.6	2.1	4	8.1	100	209	220
Do	do	Aug. 23, 1940	(1)	19.0	7.2	76.8	2.4	24	8.1	120	214	----------
Do	do	Aug. 30, 1940	1	23.5	5.8	67.1	2.3	110	8.1	120	241	----------
Salimonie River, 1 mile below Portland, Ind.	WSa 464	Aug. 16, 1940	4	25.0	0	0	8.7	24,000	7.6	30	374	344
Do	do	Aug. 23, 1940	3	19.5	0	0	10.8	9,300	7.7	23	367	----------
Do	do	Aug. 30, 1940	2	23.5	0	0	10.0	24,000	7.7	30	359	----------
Salimonie River, 3 miles below Portland, Ind.	WSa 462	Aug. 16, 1940	5	25.0	.1	1.0	11.8	46,000	7.7	17	409	348
Do	do	Aug. 23, 1940	4	19.0	0	0	17.2	46,000	7.4	55	302	----------
Do	do	Aug. 30, 1940	2	23.0	0	0	16.3	110,000	7.7	30	365	----------
Salimonie River, 0.7 mile below Montpelier, Ind.	WSa 438	July 19, 1940	7	23.5	4.0	46.5	5.6	240	7.7	450	131	204
Do	do	July 29, 1940	3	26.5	7.9	97.1	3.4	9	8.2	45	216	----------
Do	do	Aug. 6, 1940	4	26.5	6.0	74.0	6.2	24	8.0	50	258	----------
Salimonie River, below Montpelier, Ind.	WSa 437	July 19, 1940	13	23.5	4.0	46.9	4.6	93	7.6	550	133	188
Do	do	July 29, 1940	6	27.0	2.7	33.7	3.3	93	7.6	90	212	----------
Do	do	Aug. 6, 1940	6	25.5	3.0	35.9	2.7	1,100	7.6	70	242	----------
Salimonie River, above Warren, Ind.	WSa 424	July 19, 1940	26	24.0	7.8	92.0	5.8	15	8.2	110	236	272
Do	do	July 29, 1940	9	26.5	3.2	39.7	3.9	46	8.1	95	206	----------
Do	do	Aug. 6, 1940	9	26.5	5.1	62.8	4.7	46	8.1	90	240	----------
Salimonie River, below Warren, Ind.	WSa 423	July 19, 1940	10	24.0	6.4	74.8	6.0	93	8.2	110	250	288
Do	do	July 29, 1940	10	25.5	2.1	25.4	4.8	1,100	7.7	410	146	----------
Do	do	Aug. 6, 1940	10	26.0	4.2	51.6	5.7	23	7.9	60	236	----------
Salimonie River, at mouth, Lagro, Ind.	WSa 394	Aug. 19, 1940	37	22.0	6.3	71.5	3.6	46	8.1	210	238	268
Do	do	Aug. 26, 1940	28	21.0	7.2	79.9	2.3	9	8.1	130	260	----------
Do	do	Sept. 3, 1940	35	18.5	7.8	82.6	2.2	110	8.1	140	268	----------
Do	do	Nov. 5, 1940	36	13.0	9.7	91.6	1.4	9	8.1	55	271	----------
Do	do	Nov. 12, 1940	26	3.5	10.9	82.0	4.8	240	7.8	380	181	----------
Do	do	Nov. 18, 1940	32	5.5	13.6	107.6	1.1	9	7.7	12	279	----------
Do	do	Nov. 25, 1940	32	4.5	13.1	100.8	1.2	7	8.3	3	278	----------
Wabash River, above Wabash, Ind.	W 390	July 25, 1940	87	29.5	6.1	79.2	4.2	4	8.0	120	201	284
Do	do	Aug. 2, 1940	60	23.5	6.4	73.8	3.1	1	8.0	85	208	----------
Do	do	Aug. 12, 1940	45	27.0	6.3	78.1	3.6	4	8.2	120	228	----------
Do	do	Nov. 5, 1940	87	12.0	9.9	91.3	2.5	24	8.1	60	240	----------
Do	do	Nov. 12, 1940	443	6.0	10.9	87.3	3.5	240	7.8	500	160	----------

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Wabash River, below Wabash, Ind.	W 387	July 25, 1940	90	31.0	4.8	63.9	5.8	460	8.0	85	208	316
Do	do	Aug. 2, 1940	61	23.5	4.2	48.3	6.3	930	7.7	45	210	
Do	do	Aug. 12, 1940	45	26.5	3.9	48.2	4.4	24,000	7.8	65	232	
Do	do	Nov. 5, 1940	88	12.5	7.9	73.8	7.6	1,500	7.7	50	238	
Do	do	Nov. 12, 1940	446	6.0	10.2	82.1	8.5	930	7.7	550	158	
Do	do	Nov. 18, 1940	84	6.5	13.0	105.4	6.0	91	7.7	35	247	
Do	do	Nov. 25, 1940	76	6.5	11.4	92.4	8.7	930	8.1	45	247	
Wabash River, above Peru, Ind.	W 376	July 24, 1940	107	27.0	4.6	56.8	15.2	43	7.8	120	223	280
Do	do	Aug. 1, 1940	90	23.5	5.5	64.0	3.3	7	7.9	150	191	
Do	do	Aug. 9, 1940	95	23.5	4.7	54.3	3.9	15	7.7	130	240	
Do	do	Nov. 6, 1940	100	8.5	8.0	68.0	4.2	110	7.7	22	260	
Do	do	Nov. 13, 1940	334	4.5	9.8	75.6	5.6	460	7.7	300	178	
Do	do	Nov. 19, 1940	104	7.0	10.6	87.2	1.9	93	7.5	12	272	
Do	do	Nov. 25, 1940	110	7.5	9.2	76.7	2.6	64	7.5	35	266	
Little Mississinewa River, below Union City, Ind.	WMiLm 478	Aug. 15, 1940		24.5	2.6	30.8	11.4	2,400	8.0	15	404	332
Do	do	Aug. 22, 1940	(1)	18.5	2.9	30.3	8.7	24,000	8.1	20	450	
Do	do	Aug. 29, 1940	2	23.5	0	0	73.0	46,000	7.7	120	371	
Mississinewa River, above Albany, Ind.	WMi 448	Aug. 16, 1940	2	32.0	9.4	126.8	2.5	9	8.4	50	203	236
Do	do	Aug. 23, 1940	3	18.5	7.0	73.9	2.1	24	8.1	50	216	
Do	do	Aug. 30, 1940	5	23.0	5.4	62.6	2.9	46	8.1	85	224	
Mississinewa River, below Albany, Ind.	WMi 447	Aug. 16, 1940	2	29.5	7.1	92.5	6.6	3	8.4	95	222	320
Do	do	Aug. 23, 1940	3	19.0	7.0	75.4	2.8	24	8.1	80	220	
Do	do	Aug. 30, 1940	5	23.0	5.0	57.6	4.7	24	7.9	65	206	
Mississinewa River, above Eaton, Ind.	WMi 437	Aug. 16, 1940	4	29.0	7.6	98.1	2.6	4	8.1	40	224	232
Do	do	Aug. 23, 1940	4	21.5	8.7	97.2	2.6	9	8.2	45	216	
Do	do	Aug. 30, 1940	4	23.5	7.9	91.6	3.6	2	7.6	50	218	
Mississinewa River, below Eaton, Ind.	WMi 436	Aug. 16, 1940	5	29.0	5.8	74.6	5.8	4,600	8.0	55	212	224
Do	do	Aug. 23, 1940	5	21.5	7.7	86.0	3.6	2,400	8.1	45	203	
Do	do	Aug. 30, 1940	5	24.0	5.6	65.4	3.7	230	7.8	65	177	
Big Lick Creek, below Dunkirk, Ind.	WMiLi 447	Aug. 16, 1940	1	29.5	0	0	10.4	15,000	7.6	12	376	264
Do	do	Aug. 23, 1940	1	18.5	.5	5.3	7.1	230	7.7	35	374	
Do	do	Aug. 30, 1940	1	22.0	0	0	9.1	9,300	7.8	20	339	
Big Lick Creek, above Hartford City, Ind.	WMiLi 438	Aug. 19, 1940	2	22.0	6.6	74.4	4.3	1,100	7.9	110	241	336
Do	do	Aug. 26, 1940	(1)	22.5	5.6	64.2	1.9	91	7.8	55	240	
Do	do	Sept. 3, 1940	(1)	18.5	7.2	75.7	2.1	1,100	7.8	100	235	

***Big Lick Creek*, below Hartford City, Ind.**	***WMiLi 436***	**Aug. 19, 1940**	**4**	**22.0**	**6.3**	**71.7**	**7.0**	**2,400**	**7.9**	**45**	**234**	**288**
Do	do	Aug. 26, 1940	2	23.5	0	0	15.4	15,000	7.7	25	334	----------
Do	do	Sept. 3, 1940	1	17.5	0	0	33.9	24,000	7.7	40	353	----------
Little Lick Creek, below Hartford City, Ind.	WMiLiL 437	Aug. 19, 1940	2	24.5	0	0	65.0	46,000	7.6	100	374	392
Do	do	Aug. 26, 1940	2	24.0	0	0	10.2	1,500	7.5	20	254	----------
Do	do	Sept. 3, 1940	1	20.0	0	0	13.6	2,300	7.5	30	257	----------
Mississinewa River, above Gas City, Ind.	WMi 414	July 18, 1940	20	22.5	6.9	70.3	4.8	43	8.2	170	261	273
Do	do	July 26, 1940	19	28.0	4.4	55.3	3.8	4	8.0	120	254	----------
Do	do	Aug. 5, 1940	19	23.5	5.2	60.6	4.5	15	8.0	110	267	----------
Back Creek, ¾ mile below Fairmont, Ind.	WMiB 419	Aug. 19, 1940	----------	19.0	4.3	46.0	4.1	460	7.5	45	259	280
Back Creek, 1 mile below Fairmont, Ind.	WMiB 419	Aug. 19, 1940	2	19.5	1.4	15.0	19.3	2,400	7.3	35	229	248
Do	do	Aug. 26, 1940	2	21.5	2.8	30.9	9.6	430	7.6	5	380	----------
Do	do	Sept. 3, 1940	2	16.5	3.3	33.5	6.4	240	7.6	5	419	----------
Back Creek, above Jonesboro, Ind.	WMiB 415	July 18, 1940	2	20.0	6.8	74.7	6.7	43	7.8	55	238	317
Do	do	July 26, 1940	2	25.5	2.9	35.2	5.7	43	7.8	40	269	----------
Do	do	Aug. 5, 1940	2	21.0	3.3	37.0	7.4	93	7.7	30	289	----------
Mississinewa River, above Marion, Ind.	WMi 413	July 18, 1940	60	25.5	11.6	140.0	6.6	46	8.4	190	228	268
Do	do	July 26, 1940	23	28.0	6.8	85.9	5.6	93	7.9	110	243	----------
Do	do	Aug. 5, 1940	21	23.5	4.4	50.7	8.7	23	8.1	110	272	----------
Mississinewa River, below Marion, Ind.	WMi 403	July 26, 1940	54	27.5	2.0	25.5	7.8	460	7.8	4	252	332
Do	do	Aug. 5, 1940	46	24.0	4.0	46.9	2.8	9	7.9	8	272	----------
Do	do	Aug. 13, 1940	36	27.0	2.8	34.9	2.8	2	8.2	13	292	----------
Mississinewa River, at mouth, Peru, Ind.	WMi 376	July 24, 1940	62	26.5	3.7	45.5	5.2	43	7.8	95	201	260
Do	do	Aug. 1, 1940	42	24.5	6.9	81.9	4.9	4	8.1	40	212	----------
Do	do	Aug. 9, 1940	42	23.5	5.4	62.8	3.6	2	8.0	90	226	----------
Do	do	Nov. 6, 1940	50	7.5	10.5	87.5	3.9	1	8.1	20	254	----------
Do	do	Nov. 13, 1940	75	1.5	12.8	91.1	3.8	3	8.1	40	242	----------
Do	do	Nov. 19, 1940	50	4.5	13.3	102.6	2.1	1	8.1	5	253	----------
Do	do	Nov. 25, 1940	50	5.5	13.7	108.4	1.7	(1)	8.2	3	254	----------
Wabash River, below Peru, Ind.	W 370	July 24, 1940	174	27.0	5.4	66.7	6.1	43	8.0	140	204	288
Do	do	Aug. 1, 1940	140	24.5	7.0	82.6	3.4	43	8.1	90	218	----------
Do	do	Aug. 9, 1940	140	23.5	5.3	61.3	3.8	460	7.9	100	241	----------
Do	do	Nov. 6, 1940	150	8.0	10.0	84.2	5.2	460	7.7	40	254	----------
Do	do	Nov. 13, 1940	412	3.5	10.5	78.9	6.7	430	7.7	130	218	----------
Do	do	Nov. 19, 1940	165	5.5	11.4	89.9	3.5	93	7.7	12	257	----------
Do	do	Nov. 25, 1940	170	8.5	14.9	127.2	2.9	150	7.9	5	260	----------
Wabash River, above Logansport, Ind.	W 357	Sept. 30, 1940	115	16.5	13.3	135.0	8.8	4	8.4	100	203	260
Do	do	Oct. 4, 1940	200	17.5	13.2	136.9	7.1	2	8.4	60	194	----------
Do	do	Oct. 9, 1940	248	11.5	8.1	73.9	3.8	110	8.1	60	178	----------
Do	do	Nov. 6, 1940	250	8.0	12.2	102.6	5.1	9	8.1	50	244	----------
Do	do	Nov. 13, 1940	1,030	2.0	13.1	94.7	3.0	23	8.1	35	244	----------

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Wabash River, above Logansport, Ind.	W 357	Nov. 19, 1940	213	5.5	13.2	104.5	2.7	43	7.8	65	215	----------
Do	do	Nov. 26, 1940	264	2.0	13.0	94.0	3.1	23	8.1	100	251	----------
Town Branch Eel River, below Churubusco, Ind.	WEeTb 443	July 23, 1940	(1)	26.5	0	0	29.2	46,000	7.3	210	153	136
Do	do	July 31, 1940	(1)	22.5	.1	1.3	18.7	24,000	7.7	85	510	----------
Do	do	Aug. 8, 1940	(1)	17.0	2.0	20.9	13.6	4,300	7.8	200	499	----------
Eel River, below Churubusco, Ind.	WEe 438	July 23, 1940	1	25.5	2.0	24.2	1.6	36	7.8	5	308	240
Do	do	July 31, 1940	1	23.5	2.1	24.4	1.6	21	7.5	7	264	----------
Do	do	Aug. 8, 1940	1	19.0	2.6	28.0	1.4	24	7.5	7	336	----------
Thorn Creek, above Columbia City, Ind.	WEeTh 427	July 23, 1940	7	23.5	3.5	40.2	3.0	1,100	7.7	100	261	244
Do	do	July 31, 1940	7	22.5	3.5	39.7	3.5	930	7.8	12	298	----------
Do	do	Aug. 8, 1940	6	19.0	7.2	76.6	1.6	43	7.9	12	320	----------
Thorn Creek, below Columbia City, Ind.	WEeTh 425	July 23, 1940	7	24.5	1.6	19.3	8.2	4,600	7.7	330	217	264
Do	do	July 31, 1940	8	24.0	0	0	36.6	24,000	7.6	100	361	----------
Do	do	Aug. 8, 1940	7	20.0	0	0	80.8	110,000	7.7	160	394	----------
Eel River, above South Whitley, Ind.	WEe 413	July 23, 1940	75	24.5	2.9	34.6	7.6	2,400	7.7	450	214	252
Do	do	July 31, 1940	30	28.5	4.0	50.4	3.1	91	7.9	25	304	----------
Do	do	Aug. 8, 1940	23	21.0	3.4	38.2	6.6	2,400	7.8	18	329	----------
Eel River, below South Whitley, Ind.	WEe 412	July 23, 1940	87	27.0	5.6	69.0	3.9	460	7.8	80	260	296
Do	do	July 31, 1940	40	23.5	6.9	80.0	3.2	36	7.9	70	282	----------
Do	do	Aug. 8, 1940	30	22.5	7.0	79.7	2.6	46	8.0	45	313	----------
Eel River, above North Manchester, Ind.	WEe 400	July 23, 1940	152	27.0	9.3	115.6	3.6	46	7.8	25	260	212
Do	do	July 31, 1940	58	24.5	5.2	61.2	2.0	23	7.8	95	226	----------
Do	do	Aug. 8, 1940	31	23.0	6.8	77.9	2.7	93	8.0	55	299	----------
Eel River, below North Manchester, Ind.	WEe 393	July 23, 1940	148	27.5	6.7	83.9	2.4	210	8.1	35	281	220
Do	do	July 31, 1940	73	25.0	5.2	61.8	2.5	460	7.7	110	204	----------
Do	do	Aug. 8, 1940	44	24.0	9.9	115.6	4.4	240	8.2	80	277	----------
Eel River, above Logansport, Ind.	WEe 357	Sept. 30, 1940	105	15.5	10.6	105.4	2.2	9	8.1	17	263	268
Do	do	Oct. 4, 1940	100	15.0	9.9	97.4	1.4	24	8.1	18	260	----------
Do	do	Oct. 9, 1940	252	14.5	7.5	73.1	2.5	46	8.0	60	236	----------
Do	do	Oct. 11, 1940	167	16.0	8.5	85.4	1.9	23	7.9	40	216	----------
Do	do	Oct. 16, 1940	153	11.5	8.8	80.1	1.9	9	7.8	55	231	----------
Do	do	Nov. 6, 1940	177	7.5	10.5	87.5	1.4	4	7.7	12	270	----------
Do	do	Nov. 13, 1940	300	3.0	12.5	92.4	1.1	15	8.1	70	276	----------

Do	do	Nov. 19, 1940	186	5.0	13.3	104.2	1.3	110	7.9	30	217	
Do	do	Nov. 26, 1940	178	4.0	12.8	97.5	1.2	4	8.1	35	276	
Wabash River, 1¼ miles below Logansport, Ind.	W 354	Sept. 30, 1940	220	17.5	11.8	122.0	2.9	93	8.3	15	252	264
Do	do	Oct. 4, 1940	300	17.0	10.3	105.5	5.0	350	8.1	20	222	
Do	do	Oct. 9, 1940	500	13.3	7.3	69.5	5.5	350	7.8	45	230	
Do	do	Nov. 6, 1940	427	9.5	10.2	89.1	2.1	460	8.0	7	276	
Do	do	Nov. 13, 1940	1,330	3.0	13.0	96.3	3.3	93	8.1	50	290	
Do	do	Oct. 11, 1940	320	17.3	9.1	94.0	2.8	305	8.1	12	225	
Do	do	Oct. 16, 1940	360	11.8	8.1	74.1	3.1	670	7.8	35	214	
Do	do	Nov. 19, 1940	410	5.5	11.7	92.6	3.5	240	7.8	30	225	
Do	do	Nov. 26, 1940	447	2.0	11.3	81.8	3.2	1,100	8.0	12	231	
Wabash River, Georgetown, Ind	W 349	Oct. 3, 1940	310	15.5	8.4	84.1	4.0	43	8.1	45	228	264
Do	do	Oct. 4, 1940	310	18.5	10.7	113.1	4.6	142	8.2	40	230	
Do	do	Oct. 9, 1940	520	14.3	7.5	72.8	3.4	195	7.9	40	228	
Do	do	Oct. 16, 1940	377	12.0	8.4	77.6	3.8	350	8.0	60	214	
Do	do	Nov. 6, 1940	436	8.0	11.0	92.8	2.7	240	8.1	35	214	
Do	do	Nov. 13, 1940	1,340	2.0	13.2	95.4	3.4	460	8.1	85	267	
Do	do	Nov. 19, 1940	421	6.0	12.8	102.6	2.3	1,100	8.0	60	218	
Do	do	Nov. 26, 1940	457	3.0	12.0	95.8	2.8	240	8.2	18	292	
Wabash River, above Delphi, Ind	W 332	Oct. 1, 1940	240	17.5	11.4	117.9	4.0	9	8.4	60	209	236
Do	do	Oct. 8, 1940	462	16.5	7.6	76.9	3.8	460	7.9	110	184	
Do	do	Oct. 9, 1940	581	16.0	9.6	96.2	3.7	93	8.4	75	192	
Do	do	Oct. 15, 1940	370	14.5	9.1	88.5	2.0	9	8.1	60	199	
Do	do	Oct. 16, 1940	429	13.0	10.2	96.5	2.4	93	8.1	65	212	
Do	do	Nov. 7, 1940	448	6.5	11.8	95.8	2.6	240	8.1	30	250	
Do	do	Nov. 14, 1940	1,045	0	13.8	94.5	2.2	93	8.1	50	250	
Do	do	Nov. 20, 1940	455	8.0	12.9	108.4	1.6	150	8.1	70	218	
Do	do	Nov. 26, 1940	483	2.5	13.6	99.5	2.1	23	8.2	12	246	
Wabash River, below Delphi, Ind	W 330	Oct. 1, 1940	241	18.5	14.3	151.5	4.6	43	8.4	50	216	256
Do	do	Oct. 8, 1940	474	17.0	7.5	77.0	4.6	240	7.7	90	182	
Do	do	Oct. 9, 1940	597	16.0	9.6	96.8	3.8	93	8.0	45	185	
Do	do	Oct. 15, 1940	382	14.0	6.5	62.7	5.7	2,400	7.8	1,200	132	
Tippecanoe River, above Warsaw, Ind.	WTi 443	July 22, 1940	39	25.5	6.9	82.8	2.0	43	8.0	3	180	208
Do	do	July 30, 1940	25	27.5	6.9	86.2	2.4	4	8.0	5	192	
Do	do	Aug. 7, 1940	17	21.5	7.4	83.6	1.6	120	8.1	3	200	
Walnut Creek, above Warsaw, Ind	WTiWe 444	July 22, 1940	2	28.5	11.0	139.8	2.6	46	8.7	3	213	172
Do	do	July 30, 1940	2	28.5	10.8	137.8	2.0	9	8.4	3	184	
Do	do	Aug. 7, 1940	2	22.5	11.5	131.1	1.2	24	8.4	3	218	
Walnut Creek, below Warsaw, Ind	WTiWe 443	July 22, 1940	5	24.5	0	0	53.4	240,000	7.5	55	237	252
Do	do	July 30, 1940	5	26.0	0	0	40.7	460,000	7.1	20	227	
Do	do	Aug. 7, 1940	4	22.5	0	0	41.6	150,000	7.3	50	262	
Tippecanoe River, below Warsaw, Ind.	WTi 442	July 22, 1940	45	26.0	5.3	65.0	4.4	39	7.9	3	191	220
Do	do	July 30, 1940	30	27.0	3.8	47.2	3.0	43	7.7	8	191	
Do	do	Aug. 7, 1940	22	23.0	3.3	37.8	2.3	93	7.7	3	204	
Winona Lake Outlet, Warsaw, Ind	WTiWeWl 444	July 22, 1940	2	27.5	8.7	108.8	2.4	9	8.7	5	100	275
Do	do	July 30, 1940	2	30.5	8.1	107.4	2.0	2	8.7	5	101	
Do	do	Aug. 7, 1940	1	25.0	7.8	92.6	1.8	11	8.4	3	96	

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Tippecanoe River, above Bourbon, Ind.	WTi 432	July 22, 1940	75	26.0	4.9	59.2	4.4	23	7.9	10	207	244
Do	do	July 30, 1940	70	27.5	4.8	60.3	2.0	43	8.0	10	191	
Do	do	Aug. 7, 1940	40	23.5	5.8	67.4	1.8	23	8.0	7	210	
Tippecanoe River, below Bourbon, Ind.	WTi 422	July 22, 1940	82	26.5	3.6	43.6	4.0	4	8.1	5	216	230
Do	do	July 30, 1940	74	27.5	5.1	63.8	2.1	3	8.0	4	208	
Do	do	Aug. 7, 1940	50	23.5	5.9	68.6	1.8	4	8.1	3	220	
Tippecanoe River, above Rochester, Ind.	WTi 410	July 24, 1940	116	27.0	5.8	72.4	2.3	9	8.0	3	214	264
Do	do	Aug. 1, 1940	96	22.0	5.7	64.6	.9	4	8.0	3	213	
Do	do	Aug. 9, 1940	96	23.0	6.4	74.1	1.3	7	8.0	3	226	
Mill Creek, above Rochester, Ind	WTiMc 411	July 24, 1940	9	23.5	3.8	44.7	7.8	93	7.6	3	156	208
Do	do	Aug. 1, 1940	4	19.0	3.9	41.4	3.1	4	7.7	7	123	
Do	do	Aug. 9, 1940	4	21.5	4.6	51.9	1.8	4	7.7	3	167	
Mill Creek, below Rochester, Ind	WTiMc 409	July 24, 1940	11	21.0	2.0	22.4	3.2	930	7.5	3	200	236
Do	do	Aug. 1, 1940	11	14.5	2.6	25.1	2.7	430	7.5	3	203	
Do	do	Aug. 9, 1940	10	20.0	2.9	31.3	2.3	430	7.5	2	217	
Tippecanoe River, below Rochester, Ind.	WTi 408	July 24, 1940	128	25.0	4.5	53.7	2.0	93	7.8	3	207	260
Do	do	Aug. 1, 1940	107	19.0	4.8	51.3	1.7	93	7.8	3	213	
Do	do	Aug. 9, 1940	107	21.5	5.5	61.7	1.5	93	7.8	2	220	
Lake Maxinkuckee, 100 feet below Culver sewer.	do	July 22, 1940		26.5	6.3	77.9	2.7	4	8.2	3	122	146
Do	do	July 30, 1940		29.0	6.2	79.5	1.8	(1)	8.4	3	115	
Do	do	Aug. 7, 1940		25.5	5.3	62.4	1.8	11	8.1	2	122	
Lake Maxinkuckee, 900 feet below sewer.	do	July 22, 1940		26.5	7.8	95.8	2.2	4	8.6	3	122	
Tippecanoe River, above Winamac, Ind.	WTi 377	Sept. 30, 1940	100	15.0	9.2	90.8	1.6	4	8.1	2	223	236
Do	do	Oct. 4, 1940	96	16.0	8.6	86.3	1.1	9	8.1	2	200	
Do	do	Oct. 11, 1940	128	15.5	8.3	82.6	1.2	4	7.9	3	198	
Tippecanoe River, below Winamac, Ind.	WTi 375	Sept. 30, 1940	100	14.5	9.0	87.3	1.5	23	8.1	2	223	224
Do	do	Oct. 4, 1940	96	15.5	8.2	81.6	1.0	43	8.1	2	202	
Do	do	Oct. 11, 1940	128	15.0	8.0	79.3	1.4	15	7.9	3	195	
Tippecanoe River, above Monticello, Ind.	WTi 349	Sept. 30, 1940	193	19.5	8.5	91.5	1.9	4	8.1	12	191	240
Do	do	Oct. 4, 1940	195	17.0	7.9	81.1	1.4	4	7.9	17	198	
Do	do	Oct. 11, 1940	375	17.0	7.2	73.9	2.0	9	8.0	7	195	

Tippecanoe River, below Monticello, Ind	*WTi 347*	*Sept. 30, 1940*	*193*	*19.5*	*10.7*	*115.6*	*3.0*	*4*	*8.4*	*12*	*201*	*236*
Do	do	Oct. 4, 1940	195	17.0	8.4	86.3	1.6	4	8.1	15	171	
Do	do	Oct. 11, 1940	375	17.0	9.3	95.0	2.1	24	8.3	7	193	
Tippecanoe River, 3 miles above mouth.	WTi 325	Oct. 1, 1940	224	18.0	11.1	116.7	1.9	15	8.3	3	182	228
Do	do	Oct. 8, 1940	425	17.0	9.0	92.0	2.0	46	8.1	10	186	
Do	do	Oct. 9, 1940	400	17.0	9.2	95.0	2.2	46	8.2	10	175	
Do	do	Oct. 16, 1940	268	14.0	9.7	93.6	1.5	23	8.1	12	186	
Do	do	Nov. 7, 1940	257	7.5	10.7	88.7	1.9	9	8.0	3	197	
Do	do	Nov. 14, 1940	395	2.0	12.2	88.2	1.5	4	8.1	5	197	
Do	do	Nov. 20, 1940	395	9.0	11.6	100.3	1.1	4	8.1	5	191	
Do	do	Nov. 26, 1940	410	3.5	12.6	94.6	2.6	4	8.1	3	195	
Wildcat Creek, above Greentown, Ind.	WWc 382	July 25, 1940	4	27.0	2.9	35.4	5.0	4	7.7	50	264	272
Do	do	Aug. 2, 1940	2	20.0	4.2	46.0	2.2	24	7.8	70	255	
Do	do	Aug. 12, 1940	2	25.5	4.1	49.3	2.0	24	7.9	40	266	
Wildcat Greek, below Greentown, Ind.	WWc 381	July 25, 1940	5	27.0	4.9	61.0	4.5	4	8.1	40	254	280
Do	do	Aug 2, 1940	3	21.0	5.0	55.2	2.2	15	7.9	18	272	
Do	do	Aug. 12, 1940	3	25.5	6.2	74.7	2.1	4	8.0	8	274	
Wildcat Creek, above Kokomo, Ind	WWc 373	July 18, 1940	10	22.0	4.7	53.3	3.7	23	7.8	60	252	
Do	do	July 25, 1940	8	27.0	3.6	44.9	5.1	9	7.9	60	264	288
Do	do	Aug. 2, 1940	4	20.0	4.6	50.6	4.9	9	8.0	70	274	
Kokomo Creek, above Kokomo, Ind	WWcK 373	July 18, 1940		22.0	7.8	87.9	3.2	3	8.1	15	231	225
Wildcat Creek, below Kokomo, Ind	WWc 371	July 18, 1940	10	24.5	1.7	19.9	3.6	640	7.5	55	302	312
Do	do	July 25, 1940	10	27.0	.8	9.9	4.5	2,400	7.2	90	282	284
Do	do	Aug. 2, 1940	8	20.0	.4	3.9	3.6	11,000	7.2	90	290	
Prairie Creek, below Frankfort, Ind	WWcSfP 349	Oct. 1, 1940	3	16.5	.1	.8	41.3	240,000	7.6	30	418	300
Do	do	Oct. 8, 1940	4	14.5	3.8	37.4	11.3	15,000	7.6	10	264	
Do	do	Oct. 15, 1940	4	13.5	3.1	29.9	14.1	9,300	7.3	50	140	
Wildcat Creek, 2½ miles above mouth	WWc 319	Oct. 1, 1940	49	17.0	13.6	139.8	3.2	75	8.4	23	250	256
Do	do	Oct. 8, 1940	84	16.0	8.1	81.8	4.0	2,400	7.8	150	206	
Do	do	Oct. 9, 1940	64	15.5	8.8	88.1	3.3	93	8.0	70	202	
Do	do	Oct. 15, 1940	600	14.5	7.6	74.3	6.9	4,600	7.7	1,500	96	
Do	do	Oct. 16, 1940	400	14.5	9.1	88.6	3.9	230	7.6	500	126	
Do	do	Nov. 7, 1940	88	7.0	11.2	92.0	1.1	9	8.1	7	256	
Do	do	Nov. 14, 1940	108	0	13.7	93.7	1.4	43	8.1	40	259	
Do	do	Nov. 20, 1940	100	7.5	12.0	99.9	.7	4	8.1	10	278	
Do	do	Nov. 26, 1940	97	3.0	12.7	94.4	1.6	3	8.0	17	261	
Wabash River, above West Lafayette, Ind.	W 313.5	Oct. 3, 1940	603	17.0	9.2	94.6	2.0	75	8.1	27	204	252
Do	do	Oct. 10, 1940	1,040	15.5	9.6	95.4	2.6	150	8.1	45	187	
Do	do	Oct. 15, 1940	1,800	14.5	9.3	90.6	5.3	75	8.1	45	199	
Do	do	Oct. 17, 1940	1,030	16.0	10.9	109.1	6.8	210	8.0	180	214	
Do	do	Nov. 7, 1940	1,000	8.0	11.2	94.4	2.5	460	8.1	18	228	
Do	do	Nov. 14, 1940	1,760	0	13.4	91.5	2.1	43	8.1	65	235	
Do	do	Nov. 20, 1940	1,030	7.0	12.2	99.8	1.1	9	8.1	22	234	
Do	do	Nov. 22, 1940	1,030	10.5	11.9	106.1	2.5	240	8.1	12	216	

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Wabash River, below West Lafayette, Ind.	W 310	Oct. 3, 1940	608	17.0	9.2	95.0	3.5	670	8.1	17	210	256
Do	do	Oct. 10, 1940	1,040	16.8	7.9	80.6	3.2	460	7.9	35	192	
Do	do	Oct. 15, 1940	1,805	15.5	6.7	66.8	4.3	1,280	7.7	240	208	
Do	do	Oct. 17, 1940	1,030	13.5	9.4	90.2	3.1	240	7.9	85	182	
Do	do	Nov. 7, 1940	1,010	8.5	10.3	87.7	3.9	460	8.1	18	236	
Do	do	Nov. 14, 1940	1,770	1.5	13.2	94.1	3.9	460	8.1	55	240	
Do	do	Nov. 20, 1940	1,040	8.0	11.2	94.0	5.1	1,100	8.0	20	225	
Do	do	Nov. 22, 1940	1,040	9.5	10.4	90.6	3.0	210	7.9	12	220	
Wabash River, 8 miles below West Lafayette, Ind.	W 303	Oct. 3, 1940	618	17.8	8.4	87.8	3.5	780	8.0	15	216	256
Do	do	Oct. 10, 1940	1,040	15.5	7.4	73.3	3.0	240	7.8	35	185	
Do	do	Oct. 15, 1940	1,810	14.8	6.3	62.1	4.5	3,050	7.7	600	152	
Do	do	Oct. 17, 1940	1,110	13.0	8.7	82.0	2.3	1,250	7.8	110	179	
Do	do	Nov. 7, 1940	1,014	8.5	10.7	91.2	3.4	430	8.1	20	235	
Do	do	Nov. 14, 1940	1,780	3.0	12.9	95.7	8.5	240	8.1	50	236	
Do	do	Nov. 20, 1940	1,040	8.0	11.5	97.2	2.0	93	8.1	25	229	
Do	do	Nov. 22, 1940	1,040	9.5	10.4	91.0	1.8	240	7.9	40	227	
Wabash River, Independence, Ind.	W 294	Oct. 2, 1940	637	18.0	11.9	124.7	2.8	1,100	8.2	12	211	252
Do	do	Oct. 7, 1940	964	18.5	6.7	71.0	3.9	460	7.8	130	184	
Do	do	Oct. 10, 1940	1,040	14.0	7.1	68.9	2.3	93	7.7	30	185	
Do	do	Oct. 14, 1940	755	17.5	7.9	82.0	1.4	43	7.9	12	208	
Do	do	Oct. 17, 1940	1,220	13.5	7.6	72.8	2.2	240	7.7	110	177	
Wabash River, above Attica, Ind.	W 288	Oct. 2, 1940	644	17.0	12.1	124.4	3.5	122	8.2	12	177	252
Do	do	Oct. 7, 1940	973	17.8	7.0	73.0	4.9	460	7.9	150	191	
Do	do	Oct. 10, 1940	1,050	13.3	7.0	66.3	2.4	68	7.7	30	179	
Do	do	Oct. 14, 1940	771	17.5	8.2	85.0	1.9	68	7.8	25	211	
Do	do	Oct. 17, 1940	1,240	13.8	7.8	75.2	2.6	122	7.7	150	164	
Do	do	Nov. 8, 1940	952	9.0	12.0	103.2	3.5	93	8.1	20	237	
Do	do	Nov. 15, 1940	2,000	3.5	13.3	100.2	3.3	93	8.1	50	231	
Do	do	Nov. 22, 1940	1,080	9.5	10.9	94.9	1.9	43	7.9	12	223	
Wabash River below Williamsport, Ind.	W 286	Oct. 2, 1940	644	16.0	10.8	108.3	4.0	93	8.1	27	189	260
Do	do	Oct. 7, 1940	940	18.3	6.9	72.8	5.0	1,750	7.7	280	179	
Do	do	Oct. 14, 1940	771	17.0	8.1	82.8	2.4	195	7.8	23	213	
Do	do	Nov. 8, 1940	954	10.0	11.8	104.1	3.9	93	8.1	40	235	
Do	do	Nov. 15, 1940	2,000	4.5	13.3	102.5	2.7	93	8.1	70	233	
Do	do	Nov. 22, 1940	1,090	9.0	10.6	91.6	2.3	43	7.9	15	230	

Wabash River, above Covington, Ind.	*W 271*	*Oct. 2, 1940*	*679*	*14.5*	*10.8*	*100.0*	*3.1*	*13*	*8.1*	*40*	*182*	*252*
Do	do	Oct. 7, 1940	994	17.5	7.3	75.9	3.8	460	7.9	390	176	
Do	do	Oct. 14, 1940	842	17.0	9.2	94.4	2.0	43	8.1	50	250	
Wabash River, below Covington, Ind.	W 270	Oct. 2, 1940	679	14.5	10.2	99.9	2.8	13	8.1	40	186	252
Do	do	Oct. 7, 1940	994	17.3	7.2	74.6	4.9	670	7.9	290	180	
Do	do	Oct. 14, 1940	842	16.5	9.1	92.0	2.5	132	8.0	50	209	
Wabash River, Perrysville, Ind	W 264	Sept. 25, 1940	740	15.5	8.6	85.6	3.1	23	8.2	15	210	
Do	do	Oct. 2, 1940	680	15.0	9.1	89.9	1.5	9	8.1	15	211	227
Do	do	Oct. 7, 1940	994	17.0	6.8	69.6	3.9	240	7.8	400	159	
Do	do	Nov. 8, 1940	1,030	8.0	12.5	105.5	3.3	93	8.2	50	233	
Do	do	Nov. 15, 1940	2,120	2.0	13.4	96.8	2.4	240	8.1	40	233	
Do	do	Nov. 22, 1940	1,150	8.0	11.0	92.8	1.5	43	7.9	17	232	
Glen Creek, below Paxton, Ill	WVMfEbCl 342	July 24, 1943	(1)	35.0	5.7	80.9	11.6	910	8.0	70	418	165
Do	do	July 29, 1940	(1)	28.0	2.4	30.3	22.5	2,100	7.8	91	444	
Do	do	Aug. 1, 1940	(1)	23.5	3.7	43.3	24.2	24,000	7.7	77	387	
Do	WVMfEbCl 339	July 24, 1940	(1)	30.0	6.3	82.4	5.6	43	7.8	200	297	142
Do	do	July 29, 1940	(1)	30.0	3.2	41.4	14.0	240	7.7	430	241	
Do	do	Aug. 1, 1940	(1)	24.5	9.4	111.0	11.5	240	8.3	135	282	
Middle Fork Vermilion River, below Paxton, Ill.	WVMf 330	July 24, 1940	1	28.5	6.9	88.0	1.7	23	7.7	10	192	123
Do	do	July 29, 1940	1	32.0	9.1	123.0	2.9	15	8.3	10	184	
Do	do	Aug. 1, 1940	1	28.0	9.0	113.9	2.2	9	8.4	25	162	
Salt Fork Vermilion River, above Rantoul, Ill.	WVSt 339	July 25, 1940	1	28.0	7.2	90.4	1.3	110	7.9	57	258	
Do	do	July 30, 1940	1	22.5	7.1	81.4	11.3	93	7.9	5	264	185
Do	do	Aug. 2, 1940	1	19.5	7.8	84.6	1.7	240	7.9	5	262	
Salt Fork, below Rantoul, Ill	WVSt 338	July 25, 1940	2	29.5	3.6	47.0	9.5	430	7.8	5	299	
Do	do	July 30, 1940	2	22.0	1.5	17.0	9.8	4,300	7.6	5	326	183
Do	do	Aug. 2, 1940	2	19.5	1.8	18.9	18.2	2,300	7.6	5	314	
Salt Fork, 3 miles below Rantoul, Ill	WVSt 336	July 25, 1940	4	32.0	11.3	152.8	7.0	930	8.4	5	305	
Do	do	July 30, 1940	4	27.0	10.1	124.8	4.3	4,600	8.3	5	319	187
Do	do	Aug. 2, 1940	4	22.5	9.7	110.8	7.2	2,400	8.1	5	313	
Town Branch Salt Fork, below Chanute Field.	WVStTb 339	July 25, 1940	1	25.0	5.6	66.2	5.9	4,600	8.2	170	376	
Do	do	July 30, 1940	1	22.5	3.9	44.1	45.2	2,300	7.7	10	372	170
Do	do	Aug. 2, 1940	1	20.5	3.6	39.9	27.3	750	7.7	5	371	
Town Branch, 3 miles below Chanute Field.	WVStTb 337	July 25, 1940	1	28.0	5.0	63.3	6.0	93	8.1	71	396	
Do	do	July 30, 1940	1	27.0	4.9	61.2	19.0	930	8.0	200	366	191
Do	do	Aug. 2, 1940	1	21.5	6.3	71.0	17.2	930	8.1	295	372	
West Branch Salt Fork, above Champaign and Urbana.	WVStWb 333	July 25, 1940	1	32.5	9.7	132.4	3.1	9	8.1	5	198	81
Do	do	July 30, 1940	1	30.5	5.4	71.3	2.8	43	8.1	99	209	
Do	do	Aug. 2, 1940	1	26.0	5.8	70.7	2.8	93	8.0	104	207	
West Branch Salt Fork, below Champaign and Urbana.	WVStWb 330	July 25, 1940	12	27.5	7.4	91.6	10.4	2,300	7.8	5	299	
Do	do	July 30, 1940	12	27.0	9.1	113.0	12.5	4,600	7.9	10	310	127
Do	do	Aug. 2, 1940	11	24.0	8.7	101.9	8.7	2,400	8.0	5	300	

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness parts per, million
West Br. Salt Fork, 5 miles below Champaign & Urbana.	WVStWb 324	July 25, 1940	12	35.0	15.4	219.4	6.1	2	8.4	5	349	149
Do	do	July 30, 1940	12	33.5	20.4	283.6	5.1	110	9.1	10	330	
Do	do	Aug. 2, 1940	12	28.5	20.4	260.8	5.9	24	8.8	5	323	
Salt Fork, above Danville, Ill	WVSt 277	July 26, 1940	49	34.0	7.5	104.8	2.8	36	8.2	5	235	123
Do	do	July 31, 1940	54	31.0	8.1	107.3	1.9	9	8.2	5	232	
Do	do	Aug. 2, 1940	49	29.0	7.6	98.2	1.6	9	8.2	5	232	
North Fork Vermilion River, above Hoopeston, Ill.	WVNf 311	July 24, 1940	4	29.0	5.7	73.5	2.3	23	7.6	97	232	
Do	do	July 29, 1940	3	27.5	4.7	59.1	3.2	93	7.9	86	231	159
Do	do	Aug. 1, 1940	4	23.5	4.7	54.9	3.4	23	7.9	100	213	
North Fork Vermilion River, below Hoopeston, Ill.	WVNf 305	July 24, 1940	4	30.5	8.3	109.4	3.9	43	8.1	48	261	
Do	do	July 29, 1940	4	26.0	5.5	66.7	3.3	240	8.1	42	290	152
Do	do	Aug. 1, 1940	4	22.5	4.8	55.2	3.8	240	8.0	40	260	
North Fork Vermilion River, below Rossville, Ill.	WVNf 301	July 24, 1940	5	30.5	8.7	114.4	6.0	23	8.3	49	267	
Do	do	July 29, 1940	4	26.0	5.1	61.8	2.6	43	8.0	37	276	102
Do	do	Aug. 1, 1940	4	22.5	5.4	62.1	2.3	460	8.1	43	275	
North Fork Vermilion River, above Danville, Ill.	WVNf 278	July 26, 1940		32.0	8.9	120.3	2.6	3	8.3	5	191	99
Do	do	July 29, 1940		32.5	7.6	104.4	1.3	2	8.2	10	186	
Do	do	Aug. 1, 1940	142	26.0	6.6	80.0	1.5	21	8.2	10	197	
Vermilion River 1 mile below Danville, Ill.	WV 273	July 26, 1940	36	31.5	4.0	54.4	9.3	46,000	8.2	10	245	181
Do	do	July 31, 1940	36	28.0	0	0	22.6	93,000	7.6	36	248	
Do	do	Aug. 5, 1940	25	27.0	4.0	50.2	8.2	9,300	8.0	5	219	
Grape Creek, ½ mile below Danville, Ill.	WVGr 276	July 26, 1940	(1)	30.5	8.8	115.9	.8	110	8.2	5	155	117
Do	do	July 31, 1940	(1)	28.5	8.1	103.2	1.2	9	7.6	10	105	
Grape Creek, below Danville, Ill	WVGr 274	July 26, 1940	1	32.5	7.4	101.8	.8	24	7.5	5	109	151
Do	do	July 31, 1940	1	27.5	9.6	119.6	2.6	93	8.2	5	155	
Grape Creek, below Westville, Ill	WVGr 273	July 26, 1940	1	22.5	8.8	100.0	1.4	110	7.9	5	407	179
Do	do	July 31, 1940	1	20.0	9.8	107.3	1.2	29	8.0	5	405	
Do	do	Aug. 5, 1940	1	20.0	9.3	101.6	1.3	43	7.8	5	408	
Vermilion River, 4½ miles below Danville, Ill.	WV 268	July 26, 1940	50	21.0	5.5	73.0	3.0	43	7.9	5	242	152
Do	do	July 31, 1940	55	27.0	6.2	76.7	3.8	460	8.1	5	251	
Do	do	Aug. 5, 1940	50	27.0	4.5	55.5	3.4	23	7.9	5	233	

Vermilion River, ½ mile above mouth	*W V 258*	*Sept. 25, 1940*	82	14.5	7.7	75.0	2.7	46	7.9	10	227	...
Do	do	Oct. 2, 1940	82	13.5	9.5	91.0	2.2	4	8.1	5	236	169
Do	do	Oct. 7, 1940	126	17.0	5.2	53.6	8.4	240	7.6	650	157	...
Do	do	Nov. 8, 1940	100	7.0	9.6	78.7	3.8	43	7.7	2	264	...
Do	do	Nov. 15, 1940	90	3.5	12.1	90.9	4.7	2,400	7.7	35	225	...
Do	do	Nov. 22, 1940	63	8.5	8.5	72.3	1.8	93	7.7	3	268	...
Wabash River, Cayuga, Ind	W 256	Sept. 25, 1940	840	15.5	7.7	76.6	2.8	9	8.1	20	202	...
Do	do	Oct. 2, 1940	765	14.0	9.0	86.3	1.8	24	8.1	10	212	164
Do	do	Oct. 7, 1940	1,120	18.0	7.0	73.4	3.0	1,100	8.0	230	183	...
Little Vermilion River, above Georgetown, Ill.	W Lv 269	July 26, 1940	3	27.5	3.6	45.1	1.3	4	8.0	34	232	129
Do	do	July 31, 1940	2	26.5	5.0	61.7	3.0	46	8.0	34	224	...
Do	do	Aug. 5, 1940	1	25.0	4.3	51.1	2.4	93	8.0	48	228	...
Little Vermilion River, below Georgetown, Ill.	W Lv 268	July 26, 1940	3	27.5	3.7	45.7	3.0	91	7.9	37	235	99
Do	do	July 31, 1940	2	26.5	4.7	57.9	5.0	29	8.1	39	237	...
Do	do	Aug. 5, 1940	1	25.5	4.0	47.6	6.7	23	8.1	48	252	...
Prairie Creek, below Lebanon, Ind	W SuPr 313	Sept. 12, 1940	1	15.0	1.7	16.6	4.4	460	7.7	3	318	264
Do	do	Sept. 16, 1940	1	14.5	2.5	24.2	4.4	23	7.5	3	258	...
Do	do	Sept. 23, 1940	1	19.0	2.8	29.7	7.2	150	7.6	3	300	...
Sugar Creek, above Crawfordsville, Ind.	W Su 283	Oct. 1, 1940	5	14.5	8.6	84.0	2.3	4	8.1	12	220	244
Do	do	Oct. 8, 1940	7	14.0	8.0	77.0	2.1	46	7.8	45	312	...
Do	do	Oct. 15, 1940	8	14.5	8.0	77.6	1.9	23	8.0	35	208	...
Sugar Creek, below Crawfordsville, Ind.	W Su 278	Oct. 1, 1940	8	15.0	5.8	57.1	2.7	150	7.6	7	250	280
Do	do	Oct. 8, 1940	10	15.0	3.9	38.5	5.4	2,400	7.6	30	213	...
Do	do	Oct. 15, 1940	15	15.0	2.9	29.0	7.5	11,000	7.5	45	200	...
Sugar Creek, 1¼ miles above mouth	W Su 246	Sept. 25, 1940	28	15.0	8.5	83.7	2.8	15	8.0	5	205	...
Do	do	Oct. 2, 1940	28	12.5	9.0	83.7	.8	24	8.0	5	223	113
Do	do	Oct. 7, 1940	30	17.5	7.3	75.9	1.4	93	7.7	15	194	...
Do	do	Nov. 8, 1940	46	6.0	11.7	93.8	.8	7	8.0	2	242	...
Do	do	Nov. 15, 1940	63	3.5	13.8	104.0	1.5	24	7.9	12	244	...
Do	do	Nov. 22, 1940	63	10.0	11.1	98.0	1.4	24	8.0	3	250	...
Wabash River, above Montezuma, Ind.	W 240	Sept. 25, 1940	943	14.0	8.4	81.5	2.3	4	8.1	15	198	...
Do	do	Oct. 2, 1940	860	17.0	10.2	104.9	4.0	4	8.1	15	213	149
Do	do	Oct. 7, 1940	1,880	18.0	8.0	84.3	1.3	9	8.1	15	202	...
Do	do	Nov. 8, 1940	1,130	7.0	12.9	105.9	3.9	15	8.4	55	237	...
Do	do	Nov. 15, 1940	1,770	3.0	13.6	100.7	2.0	240	8.1	65	219	...
Do	do	Nov. 22, 1940	1,290	7.5	11.5	95.5	1.4	23	8.1	20	240	...
Raccoon Creek, 1½ miles above mouth.	W Ra 239	Sept. 25, 1940	28	15.0	8.3	81.6	1.7	43	7.9	10	225	...
Do	do	Oct. 2, 1940	28	12.5	9.5	88.5	.9	4	8.1	5	233	243
Do	do	Oct. 7, 1940	28	17.5	7.1	73.7	2.1	46	7.7	10	210	...
Wabash River, above Clinton, Ind	W 240	Sept. 25, 1940	970	17.0	8.8	90.6	2.9	8	8.1	15	200	...
Do	do	Oct. 2, 1940	891	17.0	10.3	105.3	3.8	2	8.1	15	216	237
Do	do	Oct. 7, 1940	1,910	18.5	8.2	87.1	2.1	8	8.2	10	227	...
Wabash River, below Clinton, Ind	W 229	Sept. 25, 1940	971	18.0	9.1	95.7	3.9	29	8.2	15	199	...
Do	do	Oct. 2, 1940	892	17.0	10.3	105.9	3.8	58	8.1	10	219	235
Do	do	Oct. 7, 1940	1,910	18.5	8.5	89.6	3.9	41	8.2	10	182	...

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
North Branch Brouillet's Creek, above Chrisman, Ill.	WBrNb 254	July 26, 1940	(1)	25.5	2.2	26.5	6.0	36	7.7	140	242	99
North Branch Brouillet's Creek, below Chrisman, Ill.	WBrNb 253	July 26, 1940	(1)	26.0	2.3	28.0	3.1	36	7.7	43	196	93
Wabash River, above Terre Haute, Ind.	W 218	Sept. 26, 1940	669	15.0	8.3	81.6	3.1	23	8.1	10	206	
Do	do	Oct. 3, 1940	700	16.5	9.0	91.5	3.9	4	8.1	10	215	197
Do	do	Oct. 8, 1940	1,530	16.5	8.0	81.0	2.1	46	8.1	10	205	
Do	do	Oct. 10, 1940	1,640	15.5	7.7	76.2	2.0	46	7.8	15	170	
Do	do	Oct. 16, 1940	1,530	12.0	8.0	74.1	2.9	240	7.7	230	162	
Do	do	Nov. 5, 1940	1,370	12.0	10.3	95.1	4.7	21	8.2	15	217	
Do	do	Nov. 12, 1940	1,620	6.0	10.9	87.7	8.3	43	8.2	75	218	232
Do	do	Nov. 18, 1940	1,540	2.0	12.9	93.4	5.4	150	8.0	20	225	
Do	do	Nov. 25, 1940	1,250	5.0	11.2	87.8	3.6	9	7.9	5	226	
Wabash River, at waterworks, Terre Haute, Ind.	W 215	Sept. 26, 1940	669	17.0	8.7	89.3	2.3	24	8.1	15	204	
Do	do	Oct. 3, 1940	700	16.5	9.3	94.2	2.4	4	8.1	10	217	169
Do	do	Oct. 8, 1940	1,530	17.0	8.2	84.4	1.9	21	8.0	5	210	
Do	do	Oct. 10, 1940	1,640	16.5	7.5	76.5	1.9	9	7.7	25	173	
Do	do	Oct. 16, 1940	1,530	14.5	7.9	77.0	2.8	240	7.7	160	167	
Do	do	Nov. 5, 1940	1,370	12.5	10.6	99.0	4.6	9	8.2	15	211	
Do	do	Nov. 12, 1940	1,620	6.0	11.1	89.3	4.7	43	8.2	90	224	212
Do	do	Nov. 18, 1940	1,540	2.5	12.9	94.7	4.6	240	8.0	20	221	
Do	do	Nov. 25, 1940	1,250	5.0	11.3	88.4	2.5	4	7.9	10	231	
Sugar Creek, 100 yards below Paris, Ill.	WSc 232	Aug. 12, 1940	1	23.5	3.8	43.6	11.4	2,400	7.2	5	188	134
Do	do	Aug. 15, 1940	1	24.0	2.8	32.8	13.6	4,600	7.4	10	294	
Do	do	Aug. 20, 1940	1	20.0	3.6	38.7	20.2	9,300	7.4	5	270	
Sugar Creek, below Paris, Ill.	WSc 231	Aug. 12, 1940	1	24.5	2.4	29.0	14.2	7,500	7.7	5	280	136
Do	do	Aug. 15, 1940	1	25.0	2.6	30.5	12.3	430	7.9	5	306	
Do	do	Aug. 20, 1940	1	19.0	1.6	17.4	6.2	2,400	7.4	10	170	
Wabash River, 2½ miles below Terre Haute, Ind.	W 210	Sept. 26, 1940	672	16.5	1.4	14.7	10.6	96,000	7.6	10	207	
Do	do	Oct. 3, 1940	705	16.0	2.1	21.4	12.3	27,300	7.6	20	224	168
Do	do	Oct. 8, 1940	1,540	16.5	3.0	29.9	12.9	33,970	7.7	20	216	
Do	do	Oct. 10, 1940	1,650	16.0	5.2	51.8	13.6	4,030	7.6	15	177	
Do	do	Oct. 16, 1940	1,540	11.5	6.4	58.7	11.0	8,700	7.8	20	188	
Do	do	Nov. 5, 1940	1,370	13.0	8.7	82.4	16.4	8,650	8.1	20	215	
Do	do	Nov. 12, 1940	1,620	6.0	10.4	83.4	13.9	330	8.1	85	218	225

Do	do	Nov. 18, 1940	1,540	2.5	12.8	93.7	11.5	930	8.0	25	227	----------
Do	do	Nov. 25, 1940	1,250	5.0	10.4	81.6	8.7	570	7.9	15	231	----------
Wabash River, 7 miles below Terre Haute, Ind.	W 205	Sept. 26, 1940	673	16.5	1.1	11.3	8.2	35,000	7.7	10	210	----------
Do	do	Oct. 3, 1940	706	16.0	1.5	15.2	9.3	18,000	7.7	10	227	167
Do	do	Oct. 8, 1940	1,540	17.0	0.8	8.7	8.2	30,500	7.7	10	214	----------
Do	do	Oct. 10, 1940	1,650	16.0	3.8	37.7	9.9	5,800	7.6	15	175	----------
Do	do	Oct. 16, 1940	1,540	11.5	5.5	50.5	8.4	9,300	7.7	10	192	----------
Do	do	Nov. 5, 1940	1,420	14.0	7.8	75.6	12.8	4,100	8.0	20	217	----------
Do	do	Nov. 12, 1940	1,640	7.0	9.8	80.3	12.5	430	8.0	75	220	222
Do	do	Nov. 18, 1940	1,620	3.0	12.4	92.0	11.0	230	8.1	25	231	----------
Do	do	Nov. 25, 1940	1,320	5.0	9.6	74.7	7.2	230	7.8	15	235	----------
Wabash River, 12 miles below Terre Haute, Ind.	W 199	Sept. 26, 1940	678	19.0	2.0	21.1	5.0	4,300	7.7	10	212	----------
Do	do	Oct. 3, 1940	711	18.0	3.9	40.8	2.6	750	8.1	5	224	225
Do	do	Oct. 8, 1940	1,540	18.0	1.6	16.7	5.5	360	7.6	5	211	----------
Do	do	Oct. 10, 1940	1,660	17.0	2.1	21.8	6.3	2,300	7.5	5	189	----------
Do	do	Oct. 16, 1940	1,540	12.0	3.2	29.7	7.8	4,300	7.6	10	194	----------
Do	do	Nov. 5, 1940	1,450	14.0	7.4	71.4	9.5	1,660	8.0	20	215	----------
Do	do	Nov. 12, 1940	1,660	7.0	9.5	78.3	10.5	840	8.1	75	216	186
Do	do	Nov. 18, 1940	1,670	3.0	12.1	89.8	10.3	430	8.0	20	227	----------
Do	do	Nov. 25, 1940	1,370	5.0	8.6	67.6	7.5	1,340	7.7	15	239	----------
Big Creek, below Marshall, Ill	WBi 198	Aug. 12, 1940	(1)	24.0	3.8	44.1	26.4	240,000	7.7	25	251	191
Do	do	Aug. 15, 1940	(1)	24.5	3.6	43.1	19.1	24,000	7.8	5	278	----------
Do	do	Aug. 20, 1940	(1)	18.5	5.0	52.8	13.0	15,000	7.8	5	254	----------
Wabash River, Darwin's Ferry	W 190	Sept. 27, 1940	1,060	18.0	3.9	41.0	3.9	580	7.7	5	215	----------
Do	do	Oct. 4, 1940	1,050	18.5	3.3	34.6	4.0	41	7.6	5	228	167
Do	do	Oct. 9, 1940	1,350	17.5	2.5	25.6	3.9	290	7.6	5	215	----------
Do	do	Oct. 11, 1940	1,720	19.0	2.6	27.6	3.6	590	7.5	5	176	----------
Do	do	Oct. 17, 1940	1,690	15.0	4.7	46.5	4.3	230	7.5	5	194	----------
Do	do	Nov. 6, 1940	1,520	11.0	5.9	53.2	9.3	2,400	8.0	15	217	----------
Do	do	Nov. 13, 1940	1,840	6.0	9.5	75.9	14.6	230	8.1	65	221	21
Do	do	Nov. 19, 1940	1,620	3.0	11.2	83.0	8.9	430	7.8	20	226	----------
Do	do	Nov. 26, 1940	1,630	6.0	8.8	70.7	7.2	241	7.7	5	233	----------
Do	do	Aug. 12, 1940	1,110	27.0	4.8	59.4	5.8	460	7.8	5	216	164
Do	do	Aug. 15, 1940	1,030	29.0	5.0	64.1	5.1	460	7.7	5	217	----------
Do	do	Aug. 20, 1940	1,190	24.0	3.5	41.3	4.6	93	7.6	5	199	----------
Wabash River, Riverview Ferry	W 182	Sept. 27, 1940	1,060	17.5	6.5	67.6	3.0	240	7.7	5	215	----------
Do	do	Oct. 4, 1940	1,050	18.0	5.2	55.0	3.4	93	7.7	5	231	140
Do	do	Oct. 9, 1940	1,350	17.5	3.3	34.6	3.7	43	7.6	5	220	----------
Do	do	Oct. 11, 1940	1,720	18.0	3.3	34.6	3.3	930	7.6	5	180	----------
Do	do	Oct. 17, 1940	1,700	15.0	4.8	47.5	3.7	430	7.5	5	196	----------
Do	do	Nov. 6, 1940	1,590	11.0	7.3	65.5	5.1	1,100	8.0	20	215	----------
Do	do	Nov. 13, 1940	1,043	6.0	10.1	80.8	8.2	2,400	8.0	65	214	195
Do	do	Nov. 26, 1940	1,705	6.0	9.1	72.9	4.4	91	7.7	5	235	----------
Do	do	Nov. 19, 1940	1,750	4.0	11.0	83.6	6.2	230	7.8	20	226	----------
Wabash River, Hutsonville Ferry	W 182	Sept. 27, 1940	1,070	17.0	7.4	76.4	3.5	15	7.9	5	216	----------
Do	do	Oct. 4, 1940	1,060	18.5	6.9	72.9	3.6	43	7.7	5	229	182
Do	do	Oct. 9, 1940	1,370	17.5	4.4	45.2	3.3	43	7.6	5	223	----------
Do	do	Oct. 11, 1940	1,750	19.0	5.1	54.8	2.7	43	7.6	5	205	----------
Do	do	Oct. 17, 1940	1,720	15.0	5.5	54.4	4.6	93	7.6	5	193	----------

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Wabash River, Hutsonville Ferry	do	Nov. 6, 1940	1,650	11.0	8.5	76.7	4.9	93	8.1	15	207	
Do	do	Nov. 13, 1940	1,850	6.0	10.1	80.6	6.6	240	8.0	60	212	231
Do	do	Nov. 26, 1940	1,770	6.0	8.3	66.3	4.6	930	7.7	5	234	
Do	do	Nov. 19, 1940	1,820	4.0	11.3	86.1	7.3	460	7.8	25	221	
Wabash River, Meron Ferry	W 165	Sept. 27, 1940	1,080	17.0	7.6	77.5	3.6	15	7.9	5	217	
Do	do	Oct. 4, 1940	1,070	17.5	6.7	69.2	3.6	4	7.8	5	227	141
Do	do	Oct. 9, 1940	1,380	16.5	1.2	11.8	8.7	36	7.6	5	227	
Do	do	Oct. 11, 1940	1,760	18.5	5.7	60.2	4.1	150	7.7	5	209	
Do	do	Oct. 17, 1940	1,730	15.0	7.4	73.3	2.1	9	7.8	5	195	
Do	do	Nov. 6, 1940	1,700	12.0	10.4	96.4	6.5	110	8.2	20	204	
Do	do	Nov. 13, 1940	1,850	6.0	11.1	88.8	7.1	240	8.0	50	213	208
Do	do	Nov. 19, 1940	1,890	4.0	11.6	88.2	7.9	1,100	7.8	20	219	
Do	do	Nov. 26, 1940	1,830	6.0	9.2	73.7	4.2	150	7.7	5	235	
LaMotte Creek, below Palestine, Ill.	WLa 159	Sept. 3, 1940	(1)	21.5	3.1	34.8	13.6	150	7.6	480	132	79
Do	do	Sept. 13, 1940	(1)	19.0	12.7	135.6	6.2	93	8.7	140	160	
Sugar Creek, ½ mile below Robinson	WLaSu 169	Sept. 3, 1940	4	20.0	0	0	58.7	46,000	7.2	38	215	157
Do	do	Sept. 9, 1940	4	21.0	1.6	17.8	35.2	4,300	7.2	25	110	
Do	do	Sept. 13, 1940	4	16.0	0	0	19.2	24,000	7.3	20	205	
Busseron Creek, 4 miles below Sullivan, Ind.	WBs 163	Sept. 27, 1940	2	12.5	4.5	42.4	4.4	230	7.3	5	95	
Do	do	Oct. 1, 1940	2	15.0	5.3	52.0	5.4	23	7.6	10	135	187
Do	do	Oct. 15, 1940	2	18.0	0	0	34.8	240,000	7.5	20	300	
Russelville Ferry, Wabash River	W 140	Sept. 4, 1940	1,640	23.0	8.0	92.4	5.6	21	8.1	20	200	158H
Do	do	Sept. 10, 1940	1,610	23.5	6.8	79.7	6.0	31	8.1	15	202	
Do	do	Sept. 16, 1940	1,590	20.0	8.8	95.5	4.6	93	8.1	20	197	
Do	do	Sept. 18, 1940	1,560	21.0	9.1	100.9	5.0	43	8.2	20	189	
Do	do	Nov. 6, 1940	1,870	12.0	9.9	91.4	3.2	46	8.0	10	187	
Do	do	Nov. 13, 1940	1,870	6.0	13.1	105.1	7.5	240	8.2	60	221	228
Do	do	Nov. 19, 1940	2,140	4.0	11.6	88.5	6.3	43	7.7	20	206	
Do	do	Nov. 26, 1940	2,020	6.0	10.3	82.9	4.2	14	7.8	5	238	
Wabash River, above Vincennes, Ind.	W 132	Sept. 4, 1940	1,640	24.0	8.5	99.6	4.1	9	8.1	10	201	172
Do	do	Sept. 10, 1940	1,610	23.0	7.2	82.9	4.2	2	8.1	15	195	
Do	do	Sept. 16, 1940	1,590	20.0	8.7	95.1	4.8	4	8.1	20	198	
Do	do	Sept. 18, 1940	1,560	21.0	9.0	100.2	4.9	2	8.2	20	190	
Do	do	Nov. 7, 1940	1,960	11.0	10.9	98.0	4.1	28	8.1	10	190	
Do	do	Nov. 14, 1940	2,280	5.0	13.3	104.1	7.8	68	8.2	60	213	222
Do	do	Nov. 20, 1940	2,280	6.0	11.4	91.3	6.2	41	7.8	35	208	
Do	do	Nov. 27, 1940	2,120	6.0	10.6	85.0	4.2	9	7.8	10	237	

Wabash River, below Vincennes, Ind	W 126	Sept. 4, 1940	1,640	23.5	7.4	85.7	5.2	3,760	8.0	15	207	180
Do	do	Sept. 10, 1940	1,610	24.0	6.4	74.7	6.8	776	8.2	15	191	
Do	do	Sept. 16, 1940	1,590	20.0	8.1	88.8	6.9	782	8.1	15	205	
Do	do	Sept. 18, 1940	1,560	21.0	6.3	70.5	8.8	3,300	8.2	15	201	
Do	do	Nov. 7, 1940	1,960	11.0	9.3	83.8	7.5	817	8.1	10	190	
Do	do	Nov. 14, 1940	2,280	5.0	13.8	108.0	9.4	543	8.3	60	221	
Do	do	Nov. 20, 1940	2,280	6.0	11.0	87.7	13.2	304	7.8	40	211	
Do	do	Nov. 27, 1940	2,120	6.0	9.3	74.6	8.9	290	7.7	15	248	
West branch Scattering Fork below Tuscola, Ill.	WEmSfWb 197	Aug. 9, 1940	(1)	22.0	0	0	32.0	46,000	7.7	15	483	
Do	do	Aug. 14, 1940	(1)	24.0	2.0	23.2	14.9	15,000	7.7	10	483	
Do	do	Aug. 19, 1940	(1)	17.0	1.6	15.9	15.0	21,000	7.6	10	310	
Riley Creek, below Mattoon, Ill	WEmR 246	Aug. 9, 1940	1	24.0	10.9	128.0	13.8	240,000	8.2	15	333	136
Do	do	Aug. 14, 1940	1	26.0	9.8	118.7	19.2	43,000	8.1	10	350	
Do	do	Aug. 19, 1940	1	18.5	5.0	52.4	10.8	93,000	7.8	10	267	
Town Branch, below Charleston, Ill	WEmRCcTb 239	Aug. 8, 1940	2	26.0	6.0	73.4	4.6	930	7.8	5	199	149
Do	do	Aug. 13, 1940	2	25.5	3.6	43.4	10.9	2,400	7.6	5	247	
Do	do	Aug. 16, 1940	2	26.0	5.0	61.3	2.8	2,300	7.6	5	215	
Cossell's Creek, below Charleston, Ill	WEmRCc 237	Aug. 8, 1940	2	29.5	15.8	204.8	3.0	21	9.1	5	219	142
Do	do	Aug. 13, 1940	2	28.0	14.7	186.1	2.5	93	8.8	5	268	
Do	do	Aug. 16, 1940	2	28.5	14.8	188.3	2.6	75	8.8	5	251	
Kickapoo Creek, below Mattoon, Ill	WEmRK 244	Aug. 9, 1940	1	24.5	0	0	34.0	24,000	7.8	15	339	138
Do	do	Aug. 14, 1940	1	25.0	0	0	27.1	43,000	7.6	15	361	
Do	do	Aug. 19, 1940	1	19.0	1.3	13.9	13.9	23,000	7.7	10	206	
Embarrass River, above Greenup, Ill.	WEm 212	Aug. 8, 1940	12	27.5	8.2	102.6	4.2	46	8.2	15	252	140
Do	do	Aug. 13, 1940	12	27.0	7.2	89.0	3.2	24	8.1	10	263	
Do	do	Aug. 16, 1940	12	27.0	6.7	82.5	5.8	4	8.1	20	257	
Embarrass River, below Greenup, Ill.	WEm 210	Aug. 8, 1940	12	27.0	7.9	97.6	4.1	93	8.1	15	258	136
Do	do	Aug. 13, 1940	12	27.5	6.8	85.6	3.4	9	8.1	15	267	
Do	do	Aug. 16, 1940	12	27.0	6.5	80.0	2.4	23	8.0	20	264	
Embarrass River, above Newton, Ill.	WEm 189	Sept. 3, 1940	31	20.0	8.0	87.0	3.2	460	8.1	70	168	143
Do	do	Sept. 9, 1940	33	21.5	6.5	72.5	3.4	23	7.8	25	195	
Do	do	Sept. 13, 1940	30	14.5	8.0	78.4	2.7	46	7.7	25	160	
Embarrass River, below Newton, Ill.	WEm 187	Sept. 3, 1940	31	20.0	7.7	83.5	4.3	240	8.1	95	162	
Do	do	Sept. 9, 1940	33	20.0	6.4	69.4	5.9	43	7.7	85	189	
Do	do	Sept. 13, 1940	30	16.0	7.8	78.0	3.0	15	8.0	20	204	
North Fork Embarrass River, below Martinsville, Ill.	WEmNf 205	Aug. 12, 1940	(1)	30.0	9.2	121.2	6.4	23	8.1	10	206	141
Do	do	Aug. 15, 1940	(1)	30.0	9.6	125.6	6.7	4	8.2	10	218	
Do	do	Aug. 20, 1940	3	20.0	5.4	58.5	4.1	240	7.5	110	106	
Town Branch, below Casey, Ill	WEmNfTb 208	Aug. 12, 1940	(1)	24.0	1.6	18.5	25.0	46,000	7.6	10	225	96
Do	do	Aug. 15, 1940	(1)	25.0	1.0	12.3	10.8	24,000	7.6	5	208	
Do	do	Aug. 20, 1940	(1)	20.0	2.6	28.6	13.0	460,000	7.5	10	138	
Dogwood Creek, below Oblong, Ill	WEmD 160	Sept. 9, 1940	(1)	21.0	2.5	28.3	18.6	11,000	7.7	25	359	
Do	do	Sept. 13, 1940	(1)	13.0	5.7	53.6	30.1	36	7.3	20	85	

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Embarrass River, above Lawrenceville, Ill.	WEm 134	Sept. 3, 1940	64	24.0	13.4	156.6	6.1	23	8.8	68	110	116
Do	do	Sept. 9, 1940	60	25.0	8.6	103.1	4.4	9	8.0	66	173	
Do	do	Sept. 13, 1940	60	21.0	10.2	113.0	3.1	4	8.2	25	190	
Embarrass River, below Lawrenceville, Ill.	WEm 130	Sept. 3, 1940	64	25.0	7.7	91.6	30.4	150	8.0	130	106	129
Do	do	Sept. 9, 1940	60	29.0	2.3	29.9	19.3	230	7.7	34	164	
Do	do	Sept. 13. 1940	20	20.0	4.2	45.8	11.0	430	7.7	15	186	
Indian Creek, below Bridgeport, Ill.	WEmIc 132	Sept. 4, 1940	1	26.5	9.9	121.9	11.6	460	8.6	5	629	308
Do	do	Sept. 9, 1940	1	25.0	9.6	114.6	7.8	230	8.5	5	578	
Do	do	Sept. 13, 1940	1	19.5	9.6	103.2	3.5	150	8.6	5	647	
Embarrass River, 1½ miles above mouth.	WEm 124	Sept. 4, 1940	70	26.0	8.3	101.0	7.1	460	8.0	20	120	133
Do	do	Sept. 9, 1940	68	25.0	4.4	52.0	4.2	93	7.8	5	170	
Do	do	Sept. 13, 1940	68	20.0	5.8	62.8	4.6	23	7.9	5	181	
Do	do	Nov. 7, 1940	35	11.0	1.7	15.3	3.8	73	7.7	5	215	
Do	do	Nov. 14, 1940	374	5.0	8.6	67.3	7.1	930	7.7	550	111	
Do	do	Nov. 27, 1940		6.0	8.1	65.1	5.6	200	7.5	30	183	
Do	do	Nov. 20, 1940	105	7.0	10.6	87.4	12.4	430	7.6	230	120	136
St. Francisville Ferry, Wabash River.	W 115	Sept. 4, 1940	1,710	26.0	9.6	116.8	7.8	93	8.1	15	188	176
Do	do	Sept. 10, 1940	1,680	25.0	8.2	97.3	5.1	191	8.2	10	184	
Do	do	Sept. 16, 1940	1,660	21.0	9.3	103.1	6.1	181	8.1	20	201	
Do	do	Sept. 18, 1940	1,630	21.5	8.7	97.4	6.3	460	8.2	20	192	
Do	do	Nov. 7, 1940	1,940	11.5	8.4	76.6	4.0	210	7.8	5	185	
Do	do	Nov. 14, 1940	2,500	4.5	11.9	91.5	9.6	210	8.2	65	206	
Do	do	Nov. 27, 1940	2,120	6.0	10.1	80.9	7.6	218	7.8	20	236	236
Do	do	Nov. 20, 1940	2,350	6.0	11.3	90.7	11.5	112	7.8	55	200	
Wabash River, above Mount Carmel, Ill.	W 97	Sept. 5, 1940	2,770	25.0	8.9	105.7	5.9	25	8.2	15	185	185
Do	do	Sept. 11, 1940	2,570	21.5	8.3	92.7	3.5	5	8.1	15	179	
Do	do	Sept. 17, 1940	2,700	21.0	7.5	83.9	5.3	22	8.1	10	205	
Do	do	Sept. 19, 1940	2,700	23.5	8.4	97.1	4.8	24	8.2	15	198	
Do	do	Nov. 8, 1940	1,830	11.0	10.5	95.0	4.8	39	8.1	10	183	
Do	do	Nov. 15, 1940	2,960	3.0	12.8	95.3	8.8	191	8.2	25	192	220
Do	do	Nov. 22, 1940	1,970	8.5	11.4	96.9	7.4	18	8.1	45	201	
Do	do	Nov. 28, 1940	2,040	3.5	12.4	93.0	6.5	22	8.0	25	233	
West Fork White River, above Winchester, Ind.	WWhWf 439	Aug. 15, 1940	2	26.5	4.4	53.4	10.3	4	7.8	65	214	236
Do	do	Aug. 22, 1940	1	19.0	4.3	45.6	2.3	9	.8	90	206	
Do	do	Aug. 29, 1940	1	22.5	3.6	40.6	2.7	15	7.8	95	212	

West Fork, White River, below Winchester, Ind.	WWhWf 437	Aug. 15, 1940	2	26.0	1.9	23.5	6.1	4,600	7.8	20	310	344
Do	do	Aug. 22, 1940	2	[illegible]	2.9	30.7	8.2	46,000	8.0	17	309	----------
Do	do	Aug. 29, 1940	2	22.5	.7	8.5	6.1	24,000	7.6	35	246	----------
West Fork, White River, above Muncie, Ind.	WWhWf 412	Aug. 21, 1940	10	21.0	9.0	100.6	2.2	46	8.2	65	239	284
Do	do	Aug. 28, 1940	7	25.0	7.2	86.2	2.8	43	8.1	40	255	----------
Do	do	Sept. 5, 1940	7	22.0	9.7	110.1	2.6	75	8.4	45	251	----------
West Fork, White River, below Muncie, Ind.	WWhWf 408	Aug. 21, 1940	14	19.5	0	0	59.6	1,100,000	6.1	70	112	376
Do	do	Aug. 28, 1940	7	24.0	0	0	14.0	3,600	7.3	35	225	----------
Do	do	Sept. 5, 1940	7	21.0	0	0	57.6	240,000	7.4	95	271	----------
West Fork, White River, 3½ miles below Muncie, Ind.	WWhWf 405	Aug. 21, 1940	14	17.5	0	0	22.8	460,000	7.1	65	236	368
Do	do	Aug. 28, 1940	7	23.0	0	0	65.4	1,100,000	7.1	100	264	----------
Do	do	Sept. 5, 1940	7	19.5	0	0	35.4	460,000	7.3	130	312	----------
West Fork, White River, above Anderson, Ind.	WWhWf 391	Aug. 21, 1940	62	24.5	9.1	107.9	6.8	460	8.2	45	264	320
Do	do	Aug. 28, 1940	66	23.5	6.5	75.7	3.7	43	8.1	25	251	----------
Do	do	Sept. 5, 1940	54	26.5	6.8	83.5	2.6	93	8.0	35	266	----------
West Fork, White River, below Anderson, Ind.	WWhWf 387	Aug. 21, 1940	62	21.5	5.3	59.5	4.0	390	8.0	55	280	284
Do	do	Aug. 28, 1940	66	25.0	2.3	27.3	4.1	4,600	7.8	35	279	----------
Do	do	Sept. 5, 1940	54	22.5	4.4	50.0	8.2	2,400	7.8	30	292	----------
Pipe Creek, above Alexandria, Ind.	WWhWfPi 397	Aug. 20, 1940	4	19.5	7.5	80.8	2.7	15	7.9	55	284	292
Do	do	Aug. 27, 1940	20	24.0	5.3	62.3	3.2	24	7.7	35	300	----------
Do	do	Sept. 4, 1940	1	19.5	7.9	85.3	1.7	24	7.7	25	312	----------
Mud Creek, below Summitville, Ind.	WWhWfPiMu 400	Aug. 20, 1940	2	18.5	2.2	23.3	34.4	11,000	7.7	30	401	376
Do	do	Aug. 27, 1940	2	22.5	.7	8.0	12.3	910	7.5	18	284	----------
Do	do	Sept. 4, 1940	1	18.0	1.3	13.5	33.5	4,600	7.7	30	455	----------
Pipe Creek, below Alexandria, Ind.	WWhWfPi 388	Aug. 20, 1940	4	20.0	2.7	29.7	7.2	4,600	7.6	15	255	268
Do	do	Aug. 27, 1940	4	24.0	1.7	19.8	6.3	30	7.7	12	292	----------
Do	do	Sept. 4, 1940	2	19.5	2.0	21.5	7.2	430	7.7	7	336	----------
Pipe Creek, 3½ miles below Alexandria, Ind.	WWhWfPi 388	Aug. 20, 1940	5	19.0	3.4	36.6	3.2	93	7.8	50	238	244
Do	do	Aug. 27, 1940	5	23.0	3.4	39.7	6.0	2,400	7.7	60	273	----------
Do	do	Sept. 4, 1940	2	18.5	3.9	41.2	4.0	460	7.8	50	316	----------
Duck Creek, 1 mile below Elwood, Ind.	WWhWfDu 382	Aug. 20, 1940	3	17.5	2.3	23.5	5.6	24,000	7.6	15	289	264
Do	do	Aug. 27, 1940	5	22.0	0	0	22.0	24,000	7.3	55	167	----------
Do	do	Sept. 4, 1940	2	----------	0	0	93.3	240,000	6.3	120	416	----------
Duck Creek, 4½ miles below Elwood, Ind.	WWhWfDu 379	Aug. 20, 1940	3	18.0	4.4	46.2	8.0	1,100	7.6	150	196	192
Do	do	Aug. 27, 1940	10	23.5	0	0	46.8	110,000	7.7	90	380	----------
Do	do	Sept. 4, 1940	4	18.0	0	0	46.5	46,000	7.7	75	415	----------
Duck Creek, at mouth	WWhWfDu 373	Aug. 20, 1940	6	19.5	4.2	45.6	4.9	240	7.9	15	347	296
Do	do	Aug. 27, 1940	5	24.0	5.1	59.2	3.2	23	7.7	12	208	----------
Do	do	Sept. 4, 1940	4	19.0	3.8	40.8	6.7	2,400	7.7	12	335	----------

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
West Fork, White River above Noblesville, Ind.	WWhWf 363	Sept. 12, 1940	50	18.5	11.6	123.0	5.7	23	8.4	23	266	296
Do	do	Sept. 16, 1940	50	18.5	11.5	121.5	5.8	9	8.1	15	256	
Do	do	Sept. 23, 1940	50	22.0	11.9	134.4	8.1	110	8.1	35	226	
Cicero Creek, below Sheridan, Ind	WWhWfCi 396	Sept. 12, 1940	(1)	16.0	6.5	65.5	5.3	21	8.1	12	347	248
Cicero Creek, 1½ miles below Tipton, Ind.	WWhWfCi 383	Sept. 12, 1940	1	18.5	13.4	141.9	7.4	2,400	8.2	7	489	340
Do	do	Sept. 16, 1940	1	18.0	13.1	137.1	7.9	930	8.5	12	424	
Do	do	Sept. 23, 1940	1	20.5	14.7	162.1	15.4	24,000	8.2	30	373	
West Fork, White River, below Noblesville, Ind.	WWhWf 360	Sept. 12, 1940	55	19.0	8.6	91.9	8.0	460	8.1	23	263	288
Do	do	Sept. 16, 1940	55	18.5	9.6	101.4	7.5	240	8.0	18	276	
Do	do	Sept. 23, 1940	55	22.0	8.7	98.9	7.4	93	7.8	35	248	
West Fork, White River, above Indianapolis, Ind.	WWhWf 349	Sept. 9, 1940	80	22.0	6.2	70.2	5.0	9	8.0	45	228	260
Do	do	Sept. 17, 1940	70	17.5	12.0	124.9	5.0	9	8.1	35	231	
Do	do	Sept. 20, 1940	60	19.5	10.3	111.2	6.9	24	8.0	45	217	
Do	do	Sept. 24, 1940	56	22.0	6.5	74.1	6.4	46	7.8	35	246	
Do	do	Sept. 27, 1940	78	12.5	8.4	78.6	5.4	2	8.0	30	250	
Indiana Central Canal, waterworks, intake, Indianapolis.	WWhWfC 337	Sept. 13, 1940	68	18.0	4.0	41.8	3.4	4	7.6	25	218	208
Do	do	Sept. 17, 1940	68	19.0	6.4	68.2	2.8	4	7.7	20	221	
Do	do	Sept. 20, 1940	68	21.5	7.9	89.0	2.9	15	7.7	22	217	
Do	do	Sept. 24, 1940	70	22.5	4.0	45.7	1.9	46	7.5	20	196	
Do	do	Sept. 27, 1940	75	16.5	3.3	33.5	1.6	4	7.5	10	212	
Fall Creek, below Middletown, Ind	WWhWfF 370	Aug. 21, 1940	2	17.5	2.5	26.1	4.6	11,000	7.6	15	310	284
Do	do	Aug. 28, 1940	2	21.0	1.9	20.7	4.9	11,000	7.6	3	317	
Do	do	Sept. 5, 1940	2	18.0	1.3	13.8	6.8	11,000	7.9	8	318	
Fall Creek, above Pendleton, Ind	WWhWfF 368	Sept. 12, 1940	10	17.0	12.7	130.6	1.6	4	8.4	7	238	280
Do	do	Sept. 16, 1940	9	18.5	12.1	127.8	1.3	4	8.2	3	270	
Do	do	Sept. 23, 1940	7	21.5	12.1	135.9	1.7	4	8.2	3	253	
Fall Creek, below Pendleton, Ind	WWhWfF 367	Sept. 12, 1940	10	18.5	7.9	83.5	2.9	1,100	8.0	8	311	280
Do	do	Sept. 16, 1940	9	18.5	8.6	91.3	2.1	39	7.9	7	266	
Do	do	Sept. 23, 1940	7	21.5	8.1	90.7	1.6	23	7.8	3	250	
Fall Creek, above Indianapolis, Ind	WWhWfF 350	Sept. 9, 1940	15	20.0	6.6	71.8	1.9	24	7.9	22	270	276
Do	do	Sept. 17, 1940	14	15.0	8.2	80.3	1.3	4	7.8	23	264	
Do	do	Sept. 20, 1940	14	17.5	6.4	66.4	.1	23	7.8	18	260	
Do	do	Sept. 24, 1940	14	19.5	6.8	73.2	1.0	8	7.8	17	268	
Do	do	Sept. 27, 1940	18	12.0	8.6	79.4	1.1	46	7.8	15	248	

Do	WWhWfF 336	Sept. 9, 1940	16	22.5	6.2	71.1	4.3	150	7.9	25	243	264
Do	do	Sept. 17, 1940	16	17.5	6.4	66.7	3.0	93	7.9	35	257	
Do	do	Sept. 20, 1940	16	20.5	8.4	92.2	3.5	2,400	8.1	18	255	
Do	do	Sept. 24, 1940	16	22.0	6.9	78.1	3.7	93	7.9	20	266	
Do	do	Sept. 27, 1940	20	14.0	8.3	80.0	4.8	240	8.1	35	236	
West Fork White River, 3½ miles below Indianapolis.	WWhWf 325	Sept. 9, 1940	136	28.5	2.4	30.6	3.2	1,100	7.8	8	274	304
Do	do	Sept. 17, 1940	128	25.0	6.3	75.2	8.3	230	7.7	8	259	
Do	do	Sept. 20, 1940	123		2.8		7.7	2,400	7.6	7	294	
Do	do	Sept. 24, 1940	121	27.0	.4	5.1	18.9	110,000	7.6	17	326	
Do	do	Sept. 27, 1940	121	22.5	2.4	27.2	7.4	2,400	7.6	4	300	
West Fork White River, 6 miles below Indianapolis, Ind.	WWhWf 323	Sept. 9, 1940	130	26.0	2.7	33.2	5.7	240	7.8	8	302	312
Do	do	Sept. 17, 1940	133	24.5	6.0	71.2	8.3	23	7.7	3	265	
Do	do	Sept. 20, 1940	139		3.3		7.7	2,400	7.7	7	305	
Do	do	Sept. 24, 1940	129	26.0	0	0	28.3	24,000	7.6	20	346	
Do	do	Sept. 27, 1940	126	20.0	3.6	39.5	7.4	1,100	7.6	3	284	
Pleasant Run, 3½ miles below Greenwood, Ind.	WWhWfPl 325	Sept. 13, 1940	(1)	15.0	8.3	81.9	5.9	4	7.8	18	230	228
West Fork White River, 18 miles below Indianapolis.	WWhWf 312	Sept. 9, 1940	138	23.5	3.0	34.4	4.3	43	7.8	10	274	288
Do	do	Sept. 17, 1940	140	21.0	4.4	49.5	7.3	7	7.7	3	268	
Do	do	Sept. 20, 1940	146		4.2		3.6	93	7.8	5	256	
Do	do	Sept. 24, 1940	140	23.0	2.9	33.6	4.7	21	7.7	5	301	
Do	do	Sept. 27, 1940	143	17.0	5.0	51.1	8.0	93	7.8	5	311	
White Lick Creek, above Mooresville, Ind.	WWhWfWl 311	Sept. 9, 1940	2	19.5	6.6	70.7	1.3	15	7.9	8	260	256
Do	do	Sept. 17, 1940	2	19.0	7.9	84.1	1.3	15	7.8	3	257	
Do	do	Sept. 24, 1940	2	21.0	5.1	56.2	1.1	93	7.7	2	270	
White Lick Creek, below Mooresville, Ind.	WWhWfWl 306	Sept. 9, 1940	4	21.5	8.3	92.9	1.9	9	7.9	10	270	272
Do	do	Sept. 17, 1940	4	18.5	9.6	101.4	1.6	2	7.9	7	260	
Do	do	Sept. 24, 1940	4	21.5	7.3	82.3	1.4	4	7.7	8	268	
West Fork White River, above Martinsville, Ind.	WWhWf 292	Sept. 10, 1940	155	21.0	10.1	111.8	4.3	2	8.2	7	256	280
Do	do	Sept. 18, 1940	155	21.0	10.6	117.5	3.5		8.3	7	258	
Do	do	Sept. 20, 1940	157		8.2		3.7	43	8.1	5	258	
Do	do	Sept. 25, 1940	154	17.5	10.5	109.1	3.3	46	8.1	3	260	
Do	do	Sept. 27, 1940	150	16.5	10.2	103.6	7.2	43	8.1	8	291	
West Fork White River, below Martinsville, Ind.	WWhWf 285	Sept. 10, 1940	156	21.5	9.9	111.1	5.8	2,400	8.1	7	265	280
Do	do	Sept. 18, 1940	156	21.5	10.8	121.1	5.9	2,300	8.4	8	264	
Do	do	Sept. 25, 1940	159	18.5	9.2	97.0	7.4	930	8.1	10	272	
West Fork White River, 4½ miles below Martinsville, Ind.	do	Sept. 10, 1940	158	21.5	9.7	109.1	5.3	460	8.2	8	259	272
Do	do	Sept. 18, 1940	158	21.0	10.4	115.8	5.2	240	8.4	10	265	
Do	do	Sept. 25, 1940	160	19.0	9.4	101.1	7.8	24,000	8.1	12	264	
West Fork White River, above Spencer, Ind.	WWhWf 262	Sept. 23, 1940	184	23.0	9.4	108.3	5.7	15	8.1	15	218	
Do	do	Sept. 30, 1940	181	16.0	10.2	102.7	7.2	460	8.2	10	266	173
Do	do	Oct. 14, 1940	178	18.0	11.5	120.3	6.1	2	8.3	15	255	

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
West Fork White River, below Spencer. Ind.	WWhWf 260	Sept. 23, 1940	186	23.5	11.7	136.0	6.8	93	8.1	15	206	----------
Do	do	Sept. 30, 1940	183	16.5	12.0	122.0	6.0	230	8.2	5	254	167
Do	do	Oct. 14, 1943	180	19.0	14.8	158.1	7.2	460	8.2	20	230	----------
West Fork White River, above mouth of Eel River.	WWhWf 236	Sept. 24, 1940	186	23.0	8.0	91.9	7.5	4	7.9	15	188	----------
Do	do	Oct. 1, 1940	178	16.0	11.1	111.6	2.3	4	8.1	10	217	166
Do	do	Oct. 15, 1940	194	15.0	8.8	87.0	7.8	4	8.1	15	198	----------
Eel River, above Greencastle, Ind	WWhWfE 306	Sept. 23, 1940	1	20.0	7.0	76.3	2.2	240	7.7	10	248	----------
Do	do	Sept. 30, 1940	1	13.5	8.8	83.6	1.7	4	7.8	5	258	193
Do	do	Oct. 14, 1940	1	17.0	7.3	74.5	1.5	15	7.7	5	252	----------
Eel River, below Greencastle, Ind	WWhWfE 300	Sept. 23, 1940	2	20.0	3.2	34.9	6.3	930	7.7	5	271	----------
Do	do	Sept. 30, 1940	2	13.5	5.5	52.3	3.9	140	7.7	5	260	----------
Do	do	Oct. 14, 1940	1	17.0	3.1	32.2	7.5	93	7.6	5	260	----------
Eel River, above Birch Creek	WWhWE 282	Sept. 23, 1940	31	23.5	8.5	98.8	1.3	29	8.2	20	235	----------
Do	do	Sept. 30, 1940	31	17.5	9.6	99.4	.8	24	8.1	10	222	202
Do	do	Oct. 14, 1940	32	20.0	9.3	101.4	.9	4	8.0	15	231	----------
Birch Creek, below Brazil, Ind	WWhWfEBi 273	Sept. 23, 1940	1	22.0	3.5	40.0	6.9	4,600	7.7	20	311	----------
Do	do	Sept. 30. 1940	1	18.5	4.4	46.4	8.6	46,000	7.8	25	344	231
Do	do	Oct. 14, 1940	1	20.5	4.2	46.5	6.4	230	7.8	10	340	----------
Eel River, below mouth Birch Creek	WWhWfE 257	Sept. 23, 1940	9	22.5	7.2	82.5	2.0	24	7.8	20	231	----------
Do	do	Sept. 30, 1940	10	16.0	9.0	90.9	2.1	9	7.8	10	205	199
Do	do	Oct. 14, 1940	10	21.0	7.3	81.4	.9	1	7.8	20	234	----------
Howesville Ditch, below Jasonville, Ind.	WWhWfEHd 250	Oct. 1, 1940	----------	12.0	11.6	106.7	1.8	23	7.8	5	134	554
Do	do	Oct. 15, 1940	1	13.0	8.4	78.9	4.4	240	7.2	5	72	----------
Eel River, at mouth, Worthington, Ind.	WWhWfE 236	Sept. 24, 1940	32	23.0	6.8	78.8	2.9	4	8.0	100	242	----------
Do	do	Oct. 1, 1940	32	16.5	8.8	88.9	1.2	8	8.0	25	226	207
Do	do	Oct. 15, 1940	32	16.0	7.4	74.6	1.4	9	8.0	100	243	----------
West Fork White River, 3½ miles below Eel River.	WWhWf 232	Sept. 24, 1940	307	23.0	7.1	82.0	5.7	93	7.9	46	196	----------
Do	do	Oct. 1, 1940	213	15.5	9.5	94.7	5.6	9	8.1	20	218	224
Do	do	Oct. 15, 1940	241	14.0	8.3	79.7	6.6	21	8.1	20	204	----------
West Fork White River Bridge on Indiana Route 58.	do	Oct. 23, 1940	214	16.0	9.4	94.3	3.9	2	8.1	25	216	234
Do	do	Oct. 28, 1940	214	18.0	8.2	85.5	3.8	4	8.1	20	229	----------
Do	do	Oct. 31, 1940	252	15.0	8.7	86.1	3.8	1	8.1	20	229	----------
Beehunter Ditch, below Linton, Ind	WWhWfB1Bd202	Sept. 24, 1940	1	21.5	7.0	78.3	3.9	240	8.1	20	434	----------
Do	do	Oct. 1, 1940	1	16.5	10.3	104.6	4.6	430	8.2	5	272	223
Do	do	Oct. 15, 1940	1	17.0	3.8	39.0	16.0	24,000	7.5	20	137	----------

Black Creek, above Marco, Ind	WWhWfB1 196	Sept. 24, 1940	3	22.5	6.4	72.7	1.2	7	7.7	10	196	----------
Do	do	Oct. 1, 1940	3	15.5	9.2	91.5	1.1	75	8.0	5	162	394
Do	do	Oct. 15, 1940	3	17.0	10.8	111.1	3.4	24	8.1	5	152	----------
Indian Creek, below Bicknell, Ind	WWhWfI 170	Oct. 23, 1940	2	19.0	7.5	80.0	1.1	2	7.7	5	233	246
Do	do	Oct. 28, 1940	2	17.0	6.9	70.6	2.3	15	7.5	4	210	----------
Do	do	Oct. 31, 1940	2	11.0	8.6	77.3	1.4	9	7.4	5	174	----------
West Fork White River above Prairie Creek.	WWhWf 162	Oct. 23, 1940	324	20.0	9.8	107.3	3.3	9	8.1	25	223	242
Do	do	Oct. 28, 1940	320	19.0	8.8	94.3	3.3	4	8.1	20	215	----------
Do	do	Oct. 31, 1940	324	15.0	9.5	93.4	3.3	1	8.1	20	225	----------
West Fork White River, below Washington, Ind.	WWhWf 160	Oct. 23, 1940	330	18.0	9.7	101.6	4.8	240	8.1	25	220	208
Do	do	Oct. 28, 1940	326	19.0	8.9	95.6	9.3	430	8.1	10	217	----------
Do	do	Oct. 31, 1940	330	16.0	9.4	94.6	5.2	430	8.1	15	220	----------
Big Blue River, above New Castle, Ind.	WWhEfDwB1 420	Aug. 21, 1940	4	16.0	10.4	104.8	1.2	24	7.8	5	331	356
Do	do	Aug. 28, 1940	4	19.5	8.3	89.6	1.2	46	7.7	3	335	----------
Do	do	Sept. 5, 1940	4	17.0	9.2	94.9	.7	110	7.7	5	341	----------
Big Blue River, below New Castle, Ind.	WWhEfDwB1 415	Aug. 21 1940	8	18.0	2.0	20.5	5.6	1,100	7.3	65	290	344
Do	do	Aug 26, 1940	8	21.0	0	0	2.8	23	6.8	110	194	----------
Do	do	Sept. 5, 1940	14	24.0	1.7	19.7	2.8	240	7.2	45	300	----------
Big Blue River, above Knightstown, Ind.	WWhEfDwB1-406	Sept. 11, 1940	22	15.5	11.9	118.8	2.4	43	8.1	10	281	344
Do	do	Sept. 19, 1940	21	19.0	11.7	124.8	1.4	23	8.1	3	280	----------
Do	do	Sept. 26, 1940	24	12.5	10.0	93.4	1.9	93	7.8	5	263	----------
Big Blue River, below Knightstown, Ind.	WWhEfDwB1-403	Sept. 11, 1940	22	15.0	11.4	112.3	4.1	1,100	8.2	5	281	320
Do	do	Sept. 19, 1940	21	18.5	10.5	111.1	1.2	240	8.1	2	289	----------
Do	do	Sept. 26, 1940	24	11.5	7.5	68.8	7.5	1,100	7.7	3	275	----------
Big Blue River, above Carthage, Ind.	WWhEfDwB1-399	Sept. 11, 1940	24	16.0	8.9	89.1	1.6	1,100	8.0	5	271	292
Do	do	Sept. 19, 1940	22	17.5	7.3	75.8	1.6	390	7.9	3	244	----------
Do	do	Sept. 26, 1940	25	12.0	7.8	72.0	2.1	240	7.8	3	266	----------
Big Blue River, below Carthage, Ind.	WWhEfDwB1-398	Sept. 11, 1940	24	16.0	6.2	62.1	4.8	93	7.9	12	289	316
Do	do	Sept. 19, 1940	22	19.0	4.7	50.5	5.9	240	7.8	8	295	----------
Do	do	Sept. 26, 1940	25	13.0	5.6	53.0	8.2	460	7.8	35	285	----------
Big Blue River, 8½ miles below Carthage, Ind.	WWhEfDwB1-389.	Sept. 11, 1940	27	16.0	7.4	74.4	3.0	9	8.1	18	266	300
Do	do	Sept. 19, 1940	25	17.5	7.0	72.8	1.7	9	8.1	10	292	----------
Do	do	Sept. 26, 1940	27	12.5	7.4	69.2	2.5	9	7.9	17	273	----------
Big Blue River above Shelbyville, Ind.	WWhEfDwB1-374.	Sept. 10, 1940	24	19.5	6.4	69.1	3.4	24	8.1	40	267	288
Do	do	Sept. 18, 1940	22	17.0	7.6	78.0	1.9	240	8.1	18	266	----------
Do	do	Sept. 25, 1940	26	16.5	6.8	68.5	2.1	21	8.0	23	261	----------
Big Blue River, below Shelbyville, Ind.	WWhEfDwB1-372.	Sept. 10, 1940	25	20.5	3.6	39.8	9.4	2,400	7.7	15	265	268
Do	do	Sept. 18, 1940	23	18.0	2.8	28.9	6.8	36	7.6	15	274	----------
Do	do	Sept. 25, 1940	26	16.5	2.8	27.9	10.9	2,400	7.7	15	248	----------

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Brandywine Creek, below Greenfield, Ind.	WWhEfDwBlBw-391.	Sept. 11, 1940	2	17.5	8.7	90.5	4.9	1,100	8.1	15	275	272
Do	do	Sept. 19, 1940	1	19.5	8.5	92.1	2.8	43	8.1	5	290	
Do	do	Sept. 26, 1940	2	14.5	7.5	72.9	4.9	1,100	7.9	3	274	
Big Blue River, 5 miles below Shelbyville, Ind.	WWhEfDwBl-367.	Sept. 10, 1940	26	20.0	6.0	65.2	3.2	240	8.0	8	264	300
Do	do	Sept. 18, 1940	24	18.0	6.3	66.0	2.0	1,100	7.9	7	270	
Do	do	Sept. 25, 1940	27	16.0	3.6	36.4	2.5	43	7.7	5	249	
Big Blue River, 3 miles above mouth, Edinburg, Ind.	WWhEfDwBl-353.	Oct. 21, 1940	51	11.5	9.5	86.9	1.2	23	7.9	8	268	296
Do	do	Oct. 24, 1940	52	14.5	8.4	81.7	1.3	23	8.0	12	282	
Do	do	Oct. 29, 1940	56	15.5	7.3	72.4	1.5	23	7.8	3	270	
Sugar Creek, above Young's Creek	WWhEfDwS-357.	Sept. 10, 1940	15	19.5	8.5	91.9	1.4	4	8.1	18	256	260
Do	do	Sept. 18, 1940	15	18.5	9.5	100.5	1.4	4	8.1	7	242	
Do	do	Sept. 25, 1940	16	15.5	11.3	112.3	1.2	9	8.1	5	226	
Youngs Creek, below Franklin, Ind	WWhEfDwSy-364	Sept. 10, 1940	2	18.5	0	0	149	15,000	7.7	80	536	352
Do	do	Sept. 18, 1940	2	16.5	.6	5.6	25.8	46,000	8.1	25	536	
Do	do	Sept. 25, 1940	3	16.0	0	0	165	24,000	7.6	85	568	
Sugar Creek, above Youngs Creek, Ind.	WWhEfDwS 356	Sept. 10, 1940	17	20.0	8.6	93.7	4.6	9	8.2	23	257	232
Do	do	Sept. 18, 1940	17	19.5	9.2	99.2	2.1	8	8.1	17	287	
Do	do	Sept. 25, 1940	19	16.0	8.2	82.7	2.2	240	8.1	13	236	
Sugar Creek, above Edinburg, Ind.	WWhEfDwS 352	Oct. 21, 1940	28	12.0	7.9	72.9	1.6	4	7.8	12	278	252
Do	do	Oct. 24, 1940	27	15.0	8.3	81.4	2.0	(1)	7.9	7	278	
Do	do	Oct. 29, 1940	30	16.0	5.8	58.7	1.6	4	7.8	5	280	
Driftwood River, below Edinburg, Ind.	WWhEfDw 350	Oct. 21, 1940	79	12.0	9.1	84.0	1.5	43	8.0	7	274	280
Do	do	Oct. 24, 1940	79	15.0	8.5	83.9	1.8	43	8.0	10	276	
Do	do	Oct. 29, 1940	86	15.0	7.3	71.9	1.4	23	7.8	8	279	
Driftwood River, above Columbus, Ind.	WWhEfDw 339	Oct. 21, 1940	92	13.5	11.5	109.6	1.6	4	8.1	7	254	268
Do	do	Oct. 24, 1940	88	16.0	9.7	97.5	1.8	4	8.0	8	258	
Do	do	Oct. 29, 1940	97	16.5	8.3	84.6	1.8	4	7.9	8	264	
Flat Rock River, above Rushville, Ind.	WWhEfDwFl-400.	Sept. 11, 1940	2	18.0	8.1	84.9	3.0	4	8.1	30	200	236
Do	do	Sept. 19, 1940	3	19.5	10.8	116.2	1.9	2	8.4	7	200	
Do	do	Sept. 26, 1940	3	15.0	7.2	71.4	3.5	15	7.8	55	184	
Flat Rock River, below Rushville, Ind.	WWhEfDwFl-395	Sept. 11, 1940	3	16.5	2.3	23.1	4.5	1,100	7.5	12	221	224
Do	do	Sept. 19, 1940	3	20.5	2.0	22.2	7.7	1,100	7.6	7	283	
Do	do	Sept. 26, 1940	3	16.5	1.8	18.3	5.4	1,100	7.5	10	172	

Flat Rock River, above Columbus, Ind.	WWhEfDwFl 344	Oct. 21, 1940	24	13.5	9.3	88.6	1.1	4	7.7	3	264	268
Do	do	Oct. 24, 1940	25	15.0	8.3	81.6	1.0	(1)	7.7	3	266	
Do	do	Oct. 29, 1940	25	15.5	7.4	73.2	1.1	(1)	7.7	2	264	
Driftwood River, below Columbus, Ind.	WWhEfDw-338	Oct. 21, 1940	118	14.5	9.3	90.7	6.9	2,400	7.8	13	256	276
Do	do	Oct. 24, 1940	115	16.5	8.4	85.3	4.6	430	7.7	12	268	
Do	do	Oct. 29, 1940	124	17.0	7.3	75.3	5.7	11,000	7.7	10	234	
Driftwood River, 10 miles below Columbus, Ind.	WWhEfDw-326	Oct. 21, 1940	143	13.5	9.1	87.1	2.3	2,400	7.9	17	264	272
Do	do	Oct. 24, 1940	143	16.5	8.0	81.4	2.6	150	7.9	5	262	
Do	do	Oct. 29, 1940	150	16.5	6.8	69.2	1.7	230	7.8	5	306	
Sand Creek, below Greensburg, Ind	WWhEfSa-370	Oct. 21, 1940	(1)	9.5	7.8	68.2	1.5	23	7.7	5	204	216
Do	do	Oct. 24, 1940	1	14.0	6.7	64.7	1.4	24	8.1	3	254	
Do	do	Oct. 29, 1940	1	15.0	4.4	43.2	2.0	9	7.8	2	286	
East fork White River above Seymour, Ind.	WWhEf-314	Oct. 22, 1940	170	15.0	11.3	110.9	2.5	43	8.1	18	266	252
Do	do	Oct. 25, 1940	176	17.5	9.7	100.2	2.0	15	8.0	12	260	
Do	do	Oct. 30, 1940	170	16.5	8.6	87.0	1.8	43	8.0	17	258	
East fork White River below Seymour, Ind.	WWhEf 307	Oct. 22, 1940	175	16.5	12.4	125.9	2.5	93	8.1	5	259	252
Do	do	Oct. 25, 1940	178	18.5	10.3	109.4	2.4	240	8.1	3	257	
Do	do	Oct. 30, 1940	175	16.5	9.6	97.5	2.4	460	8.0	5	254	
East fork White River, 13 miles below Seymour, Ind.	WWhEf-296	Oct. 22, 1940	185	15.5	8.9	88.6	7.0	1,100	7.9	3	259	252
Do	do	Oct. 25, 1940	189	18.0	7.1	74.1	4.4	1,100	7.8	3	253	
Do	do	Oct. 30, 1940	185	15.5	7.8	77.2	2.9	11,000	7.9	3	255	
Vernon fork, below Vernon, Ind	WWhEfMuV-333	Oct. 23, 1940	(1)	12.5	6.4	59.3	1.4	4	7.5	10	168	156
Do	do	Oct. 28, 1940	(1)	15.0	5.3	52.2	2.5	1	7.5	8	167	
Do	do	Oct. 31, 1940	(1)	11.5	5.3	48.4	2.1	(1)	7.5	13	158	
Muscatatuck River, below Vernon fork.	WWhEfMu-297	Oct. 23, 1940	4	13.5	0	0	210	1,500	6.9	220	276	180
Do	do	Oct. 28, 1940	5	14.0	0	0	154	230	7.1	80	302	
Do	do	Oct. 31, 1940	5	11.0	0	0	195	430	7.0	80	316	
Smart Ditch, Vernon fork	WWhEfMuVSd-295.	Oct. 23, 1940	1	13.0	8.5	79.8	1.7	15	7.7	5	174	156
Do	do	Oct. 28, 1940	1	14.5	6.5	63.4	2.0	9	7.5	5	184	
Do	do	Oct. 31, 1940	1	9.5	8.3	72.4	1.7	9	7.6	3	182	
Muscatatuck River above mouth	WWhEfMu-282	Oct. 23, 1940	6	16.0	3.0	29.7	2.1	4	7.6	25	207	180
Do	do	Oct. 28, 1940	7	15.5	3.3	32.9	3.2	(1)	7.6	5	214	
Do	do	Oct. 31, 1940	6	14.5	.2	1.9	8.1	1	7.5	15	220	
East fork White River below Muscatatuck.	WWhEf 272	Oct. 23, 1940	199	16.0	8.8	88.1	3.8	23	7.9	10	265	244
Do	do	Oct. 28, 1940	200	17.0	7.0	71.9	2.2	23	7.8	3	266	
Do	do	Oct. 31, 1940	200	13.5	8.9	85.2	1.6	4	7.9	3	257	
East fork White River above Guthrie, Ind.	WWhEf 251	Oct. 22, 1940	231	13.0	9.2	86.8	1.7	4	7.9	3	259	256
Do	do	Oct. 25, 1940	231	18.0	8.5	88.7	1.2	4	8.0	3	250	
Do	do	Oct. 30, 1940	231	15.5	8.4	83.9	1.2	(1)	8.1	3	254	

[1] Less than 1.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Clear Creek, below Bloomington, Ind.	WWhEfScCl-274	Oct. 22, 1940	3	12.0	6.7	61.8	11.1	11,000	7.6	7	183	184
Do	do	Oct. 25, 1940	4	15.5	3.3	32.8	16.1	2,400	7.2	45	136	----------
Do	do	Oct. 30, 1943	3	12.0	2.9	26.6	23.4	46,000	7.2	210	200	----------
Salt Creek at mouth, above New Bedford, Ind.	WWhEfSc-244	Oct. 22, 1940	4	13.0	2.9	27.5	2.5	240	7.6	5	170	156
Do	do	Oct. 25, 1940	4	15.0	3.2	31.3	1.7	150	7.5	3	156	----------
Do	do	Oct. 30, 1940	5	14.0	1.8	17.1	1.4	1,500	7.3	3	160	----------
East fork White River, below Bedford, Ind.	WWhEf 238	Oct. 22, 1940	262	13.3	9.0	85.4	2.1	19	8.0	10	256	240
Do	do	Oct. 25, 1940	262	15.5	8.7	86.4	1.8	12	7.9	5	249	----------
Do	do	Oct. 30, 1940	262	15.3	7.2	71.4	1.8	6	7.9	10	250	----------
East fork White River, above shoals	WWhEf 207	Oct. 21, 1940	202	16.0	10.3	103.7	2.6	1	8.2	5	214	----------
Do	do	Oct. 24, 1940	284	19.0	10.2	108.9	2.3	2	8.1	5	221	210
Do	do	Oct. 29, 1940	329	17.0	8.7	89.5	2.0	2	8.1	10	219	----------
East fork White River, Hindustan Falls.	WWhEf 189	Oct. 21, 1940	207	16.0	10.1	101.3	1.9	2	8.2	5	207	----------
Do	do	Oct. 24, 1940	295	19.0	10.2	108.7	1.8	(1)	8.2	5	219	197
Do	do	Oct. 29, 1940	347	18.0	8.4	87.6	1.9	1	8.1	10	215	----------
Lick Creek, below Paoli, Ind.	WWhEfLoLi-231	Oct. 21, 1940	2	12.0	4.6	42.5	5.2	23	7.6	15	250	----------
Do	do	Oct. 24, 1940	2	15.5	2.4	24.4	9.2	15	7.5	5	250	178
Do	do	Oct. 29, 1940	1	16.0	2.0	20.5	5.2	93	7.5	25	242	----------
Lost River, above West Baden, Ind.	WWhEfLo-217	Oct. 21, 1940	6	11.0	7.1	64.1	1.1	4	7.7	5	236	----------
Do	do	Oct. 24, 1940	6	15.0	6.2	61.1	1.3	15	7.7	5	236	225
Do	do	Oct. 29, 1940	6	15.0	4.1	40.0	2.2	4	7.5	5	239	----------
Lost River, below West Baden, Ind.	WWhEfLo-216	Oct. 21, 1940	7	12.0	0	0	6.4	4,300	7.4	5	244	----------
Do	do	Oct. 24, 1940	7	16.0	0	0	11.5	24,000	7.4	5	240	221
Do	do	Oct. 29, 1940	7	17.0	0	0	12.2	9,300	7.2	10	218	----------
East fork White River at mouth	WWhEf 148	Oct. 22, 1940	300	15.0	9.7	95.8	1.5	1	8.1	10	218	----------
Do	do	Oct. 28, 1940	297	17.5	8.1	84.0	1.5	1	7.9	15	220	222
Do	do	Oct. 31, 1940	290	13.0	8.4	78.9	1.3	2	8.0	20	226	----------
White River, 3½ miles below east and west fork junction.	WWh 143	Oct. 22, 1940	642	15.0	9.8	96.4	2.4	24	8.0	15	216	----------
Do	do	Oct. 28, 1940	626	18.0	7.9	82.4	2.0	2	8.1	20	218	230
Do	do	Oct. 31, 1940	596	14.0	8.7	83.5	2.5	4	8.0	25	221	----------
Prides Creek, below Petersburg, Ind.	WWhPr 143	Oct. 22, 1940	1	15.0	7.2	70.9	13.4	930	7.7	700	241	----------
Do	do	Oct. 28, 1940	2	19.0	8.8	93.7	4.3	4	7.8	25	213	230
Do	do	Oct. 31, 1940	1	9.0	8.6	74.2	13.0	16	7.8	10	274	----------
White River, at mouth	WWh 99	Sept. 5, 1940	1,020	25.0	8.0	96.1	3.8	9	8.1	25	176	183
Do	do	Sept. 11, 1940	850	20.0	7.7	84.2	3.1	3	8.1	25	192	----------

Do	do	Sept. 17, 1940	1,000	20.5	8.2	90.5	4.0	2	8.1	20	188	----------
Do	do	Oct. 23, 1940	650	15.0	9.4	92.1	3.8	1	8.1	20	224	210
Do	do	Oct. 25, 1940	634	18.0	9.4	99.1	4.4	1	8.1	20	228	----------
Do	do	Oct. 30, 1940	604	17.0	8.5	87.7	3.5	1	8.0	25	228	----------
Do	do	Nov. 8, 1940	720	10.0	11.1	98.0	3.9	3	8.2	10	217	----------
Do	do	Nov. 15, 1940	990	4.0	13.2	100.5	5.7	6	8.2	10	199	207
Do	do	Nov. 28, 1940	1,090	3.5	13.1	98.3	3.2	10	8.1	15	233	----------
Do	do	Nov. 22, 1940	905	9.0	13.4	115.9	5.8	4	8.2	30	220	----------
Patoka River, above Jasper, Ind	WPk 182	Oct. 21, 1940	(1)	12.0	2.8	26.2	4.0	36	7.0	15	81	----------
Do	do	Oct. 24, 1940	(1)	16.5	4.2	42.1	4.3	----------	6.9	10	83	88
Do	do	Oct. 29, 1940	(1)	16.0	1.2	11.7	5.0	----------	6.8	15	84	----------
Patoka River, below Huntingburg, Ind.	WPk 173	Oct. 21, 1940	2	10.0	3.4	30.2	5.0	23	7.2	20	96	----------
Do	do	Oct. 24, 1940	2	15.0	5.3	52.2	4.2	23	7.1	10	109	83
Do	do	Oct. 29, 1940	2	16.0	3.0	30.6	5.8	4	6.9	15	117	----------
Patoka River, above Winslow, Ind	WPk 144	Oct. 22, 1940	2	13.0	7.8	73.6	1.8	15	6.8	10	44	----------
Do	do	Oct. 25, 1940	1	16.0	5.7	57.1	3.0	75	6.8	5	50	64
Do	do	Oct. 30, 1940	1	12.0	4.3	39.5	5.9	43	6.8	5	52	----------
South Fork Ditch, above Oakland City.	WPkSf-137	Oct. 22, 1940	1	12.5	8.2	76.4	[2] 1.9 1.5	(1)	3.4	5	----------	----------
Do	do	Oct. 25, 1940	1	20.0	6.3	68.9	[2] 2.5 0.6	(1)	3.4	5	----------	1,540
Do	do	Oct. 30, 1940	2	11.0	7.6	68.6	[2] 3.0 1.3	(1)	3.4	5	----------	----------
Patoka River, above Patoka, Ind	WPk 112	Oct. 23, 1940	4	13.5	8.2	78.1	[2] 1.4 0.8	(1)	4.7	5	----------	436
Do	do	Oct. 25, 1940	4	19.0	7.8	83.4	[2] 2.0 1.1	(1)	4.7	10	----------	----------
Do	do	Oct. 30, 1940	4	12.0	7.8	71.8	1.8	2	6.8	25	180	----------
Patoka River at mouth	WPk 96	Sept. 11, 1940	31	17.0	7.4	76.4	1.5	9	7.4	5	81	----------
Do	do	Sept. 17, 1940	34	19.0	7.3	78.5	1.3	43	6.5	15	25	----------
Do	do	Sept. 19, 1940	28	21.0	7.7	85.2	2.3	4	7.0	5	43	146
Do	do	Nov. 8, 1940	----------	9.0	9.6	82.5	.9	4	7.6	5	179	----------
Do	do	Nov. 15, 1940	----------	3.5	10.9	82.0	1.5 [2] 2.1	(1)	4.5	5	----------	448
Do	do	Nov. 28, 1940	----------	4.0	10.9	83.0	1.2 [2] 2.4	5	4.4	5	34	----------
Do	do	Nov. 22, 1940	----------	9.0	10.1	87.3	1.8	9	6.5	5	41	----------
Wabash River, below Mt. Carmel, Ill.	W 93	Sept. 5, 1940	1,720	26.0	8.1	98.3	5.8	97	8.0	20	176	193
Do	do	Sept. 11, 1940	1,690	21.5	7.0	78.8	5.0	316	8.1	20	185	----------
Do	do	Sept. 17, 1940	1,670	21.0	7.5	83.8	4.0	86	8.1	10	196	----------
Do	do	Sept. 19, 1940	1,640	22.5	7.8	88.8	3.9	20	8.1	20	199	----------
Do	do	Nov. 8, 1940	2,540	11.0	10.5	95.1	5.9	16	8.1	10	190	----------
Do	do	Nov. 15, 1940	3,930	3.0	13.1	97.2	8.3	89	8.2	20	204	22
Do	do	Nov. 22, 1940	2,860	8.5	12.8	108.8	6.1	23	8.2	40	207	----------
Do	do	Nov. 28, 1940	3,110	3.5	12.7	95.6	6.8	85	8.1	20	225	----------
McCarty Ditch, below Princeton, Ind	WCby-Mcd-96	Oct. 23, 1940	2	14.0	6.7	64.7	13.0	240	7.7	5	235	436
Do	do	Oct. 25, 1940	2	20.0	7.1	77.4	12.8	240	7.5	15	224	----------
Do	do	Oct. 30, 1940	2	12.0	7.1	65.2	13.0	2,400	7.5	10	248	----------

[1] Less than 1.
[2] Neutralized and seeded.

TABLE W-7.—*Wabash River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Wabash River, Hovey Ferry, Ind	W 62	Sept. 5, 1940	3,000	25.0	7.6	90.8	4.5	12	8.2	15	195	181
Do	do	Sept. 6, 1940	2,950	25.5	7.3	87.7	4.0	5	8.1	15	175	....
Do	do	Sept. 12, 1940	2,850	20.5	7.8	85.8	3.7	5	8.1	15	192	....
Do	do	Sept. 19, 1940	2,700	22.5	7.7	87.9	4.0	4	8.0	20	196	....
Wabash River, below New Harmony, Ind.	W 51	Sept. 5, 1940	3,010	25.0	6.9	82.3	5.1	5	8.1	10	202	168
Do	do	Sept. 6, 1940	2,960	24.5	7.0	82.6	4.4	9	8.0	15	183	....
Do	do	Sept. 12, 1940	2,860	20.5	8.0	87.6	3.7	5	8.1	15	194	....
Do	do	Sept. 19, 1940	2,710	23.0	7.4	85.6	5.5	4	8.0	20	196	....
Do	do	Nov. 8, 1940	2,540	11.0	9.4	85.2	6.7	13	8.1	10	203	....
Do	do	Nov. 15, 1940	3,930	2.0	12.8	92.3	8.0	21	8.2	25	192	213
Do	do	Nov. 28, 1940	3,110	3.0	12.3	91.2	6.4	25	8.2	20	211	....
Do	do	Nov. 22, 1940	2,860	8.5	12.3	104.9	8.6	12	8.4	55	210	....
Branch Little Wabash Creek, below Mattoon, Ill.	W LW Br 228	Aug. 9, 1940	1	24.0	1.7	20.2	39.0	46,000	7.9	25	301	139
Do	do	Aug. 14, 1940	1	26.0	2.4	28.7	20.0	93,000	7.8	10	318	....
Do	do	Aug. 19, 1940	1	19.0	3.6	38.1	10.2	23,000	7.7	5	219	....
Lake Mattoon, below Mattoon, Ill	W Lw 225	Aug. 9, 1940	....	26.0	8.2	100.0	2.7	2	8.7	5	113	....
Do	do	Aug. 14, 1940	....	27.0	7.9	98.1	1.6	4	8.6	5	118	....
Do	do	Aug. 19, 1940	....	23.5	5.8	67.4	3.0	4	8.0	5	119	....
Big Creek, below Altamont, Ill	W Lw Bg 194	Aug. 8, 1940	(1)	23.5	4.8	56.4	9.8	11,000	7.6	5	173	150
Do	do	Aug. 13, 1940	(1)	23.5	7.0	81.2	10.0	2,300	7.4	10	153	....
Do	do	Aug. 16, 1940	(1)	28.0	2.9	36.7	11.4	2,400	7.4	25	135	....
Salt Creek, above Effingham, Ill	W Lw Sa 194	Aug. 8, 1940	(1)	23.5	3.7	43.0	3.3	1,100	7.7	5	260	147
Do	do	Aug. 13, 1940	(1)	24.5	2.3	27.0	2.9	93	7.8	5	269	....
Salt Creek, below Effingham, Ill	W Lw Sa 192	Aug. 8, 1940	1	24.5	4.9	58.0	2.3	430	7.6	5	167	132
Do	do	Aug. 13, 1940	1	24.0	4.3	49.9	2.9	91	7.5	5	203	....
Do	do	Aug. 16, 1940	1	26.0	5.2	63.9	2.9	930	7.6	5	167	....
Fox River, above Olney, Ill	W Lw Fx 132	Aug. 30, 1940	....	24.5	7.5	88.4	5.1	23	7.1	10	68	....
Do	do	Sept. 6, 1940	....	25.0	6.5	77.3	4.4	4	7.2	25	70	66
Do	do	Sept. 12, 1940	....	19.0	5.8	62.0	4.9	24	7.2	20	61	....
Fox River, below Olney, Ill	W Lw Fx 130	Aug. 30, 1940	2	24.0	1.5	17.6	11.9	46,000	7.5	10	218	....
Do	do	Sept. 6, 1940	2	25.0	6.1	73.0	5.1	360	7.6	28	156	100
Do	do	Sept. 12, 1940	2	17.5	3.8	39.0	6.0	430	7.6	15	202	....
Seminary Creek, below Flora, Ill	W Lw El Sy 120	Aug. 30, 1940	(1)	22.0	2.3	25.0	14.7	430	7.5	5	221	....
Do	do	Sept. 6, 1940	(1)	20.5	1.1	11.6	25.8	24,000	7.7	25	617	206
Do	do	Sept. 12, 1940	(1)	16.0	4.6	46.2	4.6	360	7.8	5	291	....
Pond Creek, below Fairfield, Ill	W Lw Po 93	Aug. 30, 1940	1	23.5	2.2	25.1	5.5	230	7.5	5	192	....
Do	do	Sept. 6, 1940	1	22.5	7.9	90.7	9.4	230	7.7	5	199	181
Do	do	Sept. 12, 1940	1	17.0	4.5	46.2	7.4	2,400	7.6	5	181	....

Butler Creek, below Albion, Ill	W Lw Bu 81	Aug. 30, 1940	(1)	22.5	4.4	50.9	21.0	2,300	7.7	5	347	
Do	do	Sept. 6, 1940	(1)	20.5	4.9	53.7	22.2	2,300	7.7	5	407	147
Do	do	Sept. 12, 1940		14.0	6.3	60.4	7.7	4,600	7.7	5	411	
Little Wabash River, above Carmi, Ill.	W Lw 43	Aug. 23, 1940	42	24.0	5.7	66.6	2.2	120	7.6	5	175	113
Do	do	Aug. 26, 1940	40	24.5	4.8	56.8	2.0	9	7.6	10	188	
Do	do	Aug. 27, 1940	35	26.0	6.8	83.0	2.3	2	7.7	10	186	
Little Wabash River, below Carmi, Ill.	W Lw 41	Aug. 23, 1940	42	24.5	7.5	89.2	3.9	430	8.1	5	167	107
Do	do	Aug. 26, 1940	40	25.0	4.9	58.2	5.3	91	7.7	5	183	
Do	do	Aug. 27, 1940	35	26.5	6.5	80.3	2.2	2,400	7.8	5	97	
Wabash River, at mouth	W 0.5	Sept. 9, 1940	2,780	25.0	7.3	87.0	2.5	2	8.2	70	191	
Do	do	Sept. 11, 1940	3,060	20.5	8.6	94.9	2.6	2	8.2	50	209	
Do	do	Sept. 13, 1940	3,370	21.0	8.8	98.0	2.4	2	8.3	49	196	170
Do	do	Sept. 17, 1940	2,780	23.0	8.7	100.6	2.4	2	8.3	50	198	
Do	do	Nov. 4, 1940	3,010	15.5	9.8	97.5	2.4	5	8.3	18	207	
Do	do	Nov. 6, 1940	3,010	12.5	10.3	96.3	2.9	4	8.2	20	219	150
Do	do	Feb. 25, 1941	5,890	3.5	14.1	106.0	3.7	(1)	8.1	20	203	
Do	do	Feb. 27, 1941	6,280	.5	14.3	99.2	2.9	1	8.1	12	202	196

[1] Less than 1.

CUMBERLAND RIVER BASIN

CONTENTS

	Page
Contents	771
Syllabus and conclusions	773
Description	774
Presentation of field data	775
Presentation of laboratory data	778
Hydrometric data	781
Discussion	783

LIST OF TABLES

C-1.	Cost estimates of remedial measures	774
C-2.	Surface water supplies	776
C-3.	Sources of pollution	776
C-4.	Industrial wastes	777
C-5.	Selected laboratory data	778
C-6.	Monthly mean summer flows	781
C-7.	Summary of laboratory data	785

LIST OF FIGURES

C-1.	Map—Sources of Pollution	773
C-2.	Chart—Sources of pollution and selected laboratory data	776
C-3.	Map—Coliform results	780
C-4.	Map—Dissolved oxygen results	780
C-5.	Map—Biochemical oxygen demand results	780
C-6.	Chart—Summer low-flow frequency curve	782

Fig. C-1

GREEN — CUMBERLAND BASINS

SOURCES OF POLLUTION

10 0 10 20 30
SCALE OF MILES

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 773)

GPO-43 O-9835

CUMBERLAND RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Cumberland River drains about 18,000 square miles in the States of Kentucky and Tennessee. The area is predominantly rural with a scattering of industries in the larger towns. One large city, Nashville, located on the main Cumberland River, contributes 55 percent of the total pollution load. An increasing number of water supplies is being taken from surface sources because of the inadequacy and undesirable characteristics of certain ground-water sources. About one-third of the domestic sewage is treated, which reflects some progress toward pollution abatement. The installation of proven methods of treatment should permit more extensive use of the stream for recreation and water supply. Wolf Creek Reservoir, now under construction, will benefit the main Cumberland River and reduce the treatment requirements at Nashville.

CONCLUSIONS

(1) Nearly twice as many communities are served by ground water as by surface supplies although the actual population served by the latter exceeds the former. Ground-water supplies are limited and are not of the best chemical quality. As a consequence, many have been abandoned for surface-water supplies. In general, surface supplies are not seriously affected by pollution.

(2) The sewered population of the basin is about 273,000 and the sewered-population equivalent of industrial wastes is 258,000. About one-third of the sewered communities have sewage-treatment facilities and about one-third of the waste-producing industries have taken at least minor steps to reduce the amount of pollution discharged. Existing treatment works reduce the total pollutional load by approximately 13 percent.

(3) Laboratory studies indicate the pollution problem to be acute below Nashville, Tenn., on the main stream, and below Princeton, Hopkinsville, Middlesboro and Corbin, Ky., on tributary streams. Tennessee State Health Department stream-sampling results have shown low dissolved oxygen below the following additional Tennessee communities: Gallatin, Lebanon, Murfreesboro, Franklin, and Dickson.

(4) The major sources of pollution, both domestic and industrial, are at Nashville on the main river. A few sections of tributary streams are grossly polluted and create problems that are primarily of local concern.

(5) With the expected increase in low-water flow from the Wolf Creek Reservoir, now under construction, the sewage treatment required at Nashville will consist of sedimentation, to reduce scum and sludge deposits. The minimum tangible monetary benefit of this flow regulation, computed as equivalent to savings in treatment cost in the Nashville area, amounts to about $50,000 annually. In addition, this increase in flow is desirable for aquatic life.

(6) In view of the normal uses of the streams involved, refined treatment at certain sources of pollution would serve no purpose commensurate with the expenditure. In these instances, lesser treatment appears justified. A summary of cost estimates of remedial measures from table C–1 follows:

Treatment	Capital cost	Annual charges
Existing	$1,660,000	$165,000
Suggested additional	7,140,000	565,000

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are—

Treatment	Capital cost	Annual charges
Primary, all places	$6,750,000	$515,000
Secondary, all places	10,160,000	805,000

TABLE C–1.—*Cumberland River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	7	10	64,300	$1,660,000	$105,000		$165,000
Suggested minimum correction:							
Sewage-treatment plants	13	18	172,000	$2,330,000	$165,000	$135,000	$300,000
Required interceptors				4,540,000	215,000		215,000
Independent industrial waste correction				270,000	35,000	15,000	50,000
Total				7,140,000	415,000	150,000	565,000
Comparative cost:							
Primary treatment all waste				6,750,000	385,000	130,000	515,000
Secondary treatment all waste				10,160,000	625,000	180,000	805,000
As suggested				7,140,000	415,000	150,000	565,000

DESCRIPTION

The Cumberland River Basin has a total drainage area of about 18,000 square miles, of which 40 percent lies in Kentucky and 60 percent in Tennessee. The Cumberland River, formed in southeastern Kentucky by the confluence of Poor and Clover Forks, flows westerly and southwesterly into Tennessee, then northwesterly across

Kentucky to its confluence with the Ohio River. The topography is mountainous to hilly in the upper reaches, gradually changing to a rolling terrain in the center of the basin, which continues as such to the mouth.

Major Tributaries	Distance above mouth	Drainage area, square miles	Major Tributaries	Distance above mouth	Drainage area, square miles
Little River	59	582	Obey River	382	920
Red River	126	1,405	Big South Fork River	516	1,370
Harpeth River	153	895	Rockcastle River	541	772
Stone River	206	924	Laurel River	546	282
Caney Fork River	309	2,620			

	Populations			
	1910	1920	1930	1940
Larger cities:				
Nashville, Tenn	110,364	118,342	153,866	167,402
Clarksville, Tenn	8,548	8,110	9,242	11,831
Middlesboro, Ky	7,305	8,041	10,350	11,777
Hopkinsville, Ky	9,419	9,696	10,746	11,724
Murfreesboro, Tenn	4,679	5,367	7,993	9,495
Total basin:				
Urban	156,993	183,516	245,348	277,724
Rural	701,603	730,492	758,436	851,278
Total	858,596	914,008	1,003,784	1,129,002

Resources.—Natural resources of the basin consist of tillable land, forests, coal, zinc, fluorite, iron ore, phosphate rock, limestone, oil, sand, and gravel. There are large potential water-power developments.

Industries.—Agriculture and its allied branches, milk and meat products, are important industries. Lumbering and wood product plants are common and in the upper reaches of the basin extensive mining operations are carried on. There is some manufacturing of cement, rayon, paper, textiles, and shoes. Oil is refined at three small plants.

Water uses.—Extensive use is made of the streams for recreational purposes, including fishing, bathing, and boating. The rivers and streams serve for the disposal of sewage and industrial waste. A series of low dams allows commercial navigation to move upstream about 330 miles from the mouth of the river. The use of surface water for domestic supplies is increasing. One hydroelectric reservoir on Caney Fork River has been built by private interests and is now a part of the system of the Tennessee Valley Authority. Three additional reservoirs for flood control and power are now being constructed by the United States Engineer Department.

Presentation of Field Data

Figure C–2 shows graphically the main stream and tributaries, water-works intakes, dams, all major sources of pollution, their magnitude and reduction by present methods of treatment and other pertinent information. Laboratory data, indicating the most unfavorable pollution conditions, are shown graphically for certain sections of the main stream.

TABLE C–2.—*Cumberland River Basin: Surface water supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption million gallons per day
	Supplies below community sewer outfalls					
State Penitentiary	Kentucky	Cumberland River	43.6	CD	1,600	0.23
Eddyville	do	do	43.6	FD	1,100	.49
Clarksville	Tennessee	do	126.9	FD	9,500	.84
State Penitentiary	do	do	182.4	CD [3]	2,100	.40
Nashville	do	do	194.0	FD	185,000	18.90
Madison	do	do	200.4	FD	5,400	.40
Old Hickory	do	do	218.3	FD	10,500	1.05
Gallatin	do	do	239.5	FD	4,000	.17
Lebanon	do	do	264.0	FD	5,000	.62
Burkesville	Kentucky	do	427.0	FD	700	.02
Williamsburg	do	do	579.5	FD	2,000	.11
State Home for Feeble Minded	Tennessee	Stone River	212.0	FD	700	.12
Burnside	Kentucky	South Fork Cumberland River	516.1	D	800	.03
Harlan	do	Poor Fork	669.7	FD	7,500	.26
Cumberland	do	do	690.3	FD	2,500	.12
Evarts	do	Clover Fork	678.6	FD	1,000	.04
Total:						
Below sewer outfalls					239,400	23.80
14 other surface supplies					51,400	3.88
Total surface water supplies					290,800	27.68

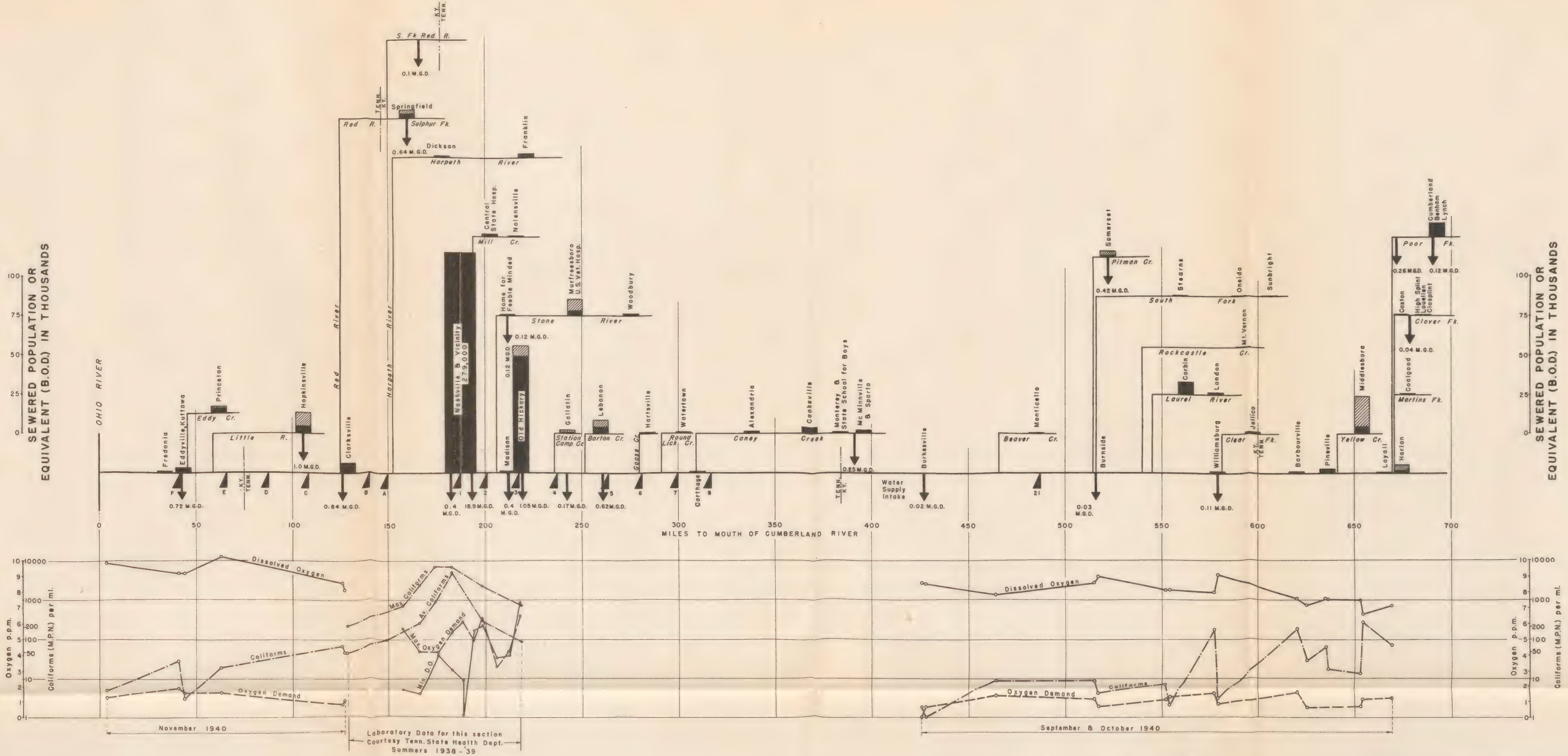
[1] Miles above mouth of Cumberland River.
[2] F=Coagulated, settled, filtered; C=Coagulated, settled; D=Chlorinated.
[3] Not used for drinking.

Public water supplies.—Of 92 public water supplies, serving 368,000 persons, 16, indicated in table C–2, are from streams below community sewer outfalls. Of the remaining supplies, 60 percent are disinfected and many in addition have filtration. A number of ground water sources are inadequate or unsatisfactory, containing hydrogen sulfide or undesirable minerals, or showing increases in turbidity and bacterial counts after rains. Below Nashville for 65 miles to Clarksville, no large towns use the Cumberland River as a source of supply.

Sewerage.—Of 56 sewered communities in the basin, 7 have primary treatment and 10 secondary treatment. About 27 percent of the domestic sewage in the basin is treated in these 17 plants. Table C–3 shows data on the larger sources of pollution including industrial wastes.

TABLE C–3.—*Cumberland River Basin: Sources of significant pollution including industrial waste expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Stream	Miles above mouth of Cumberland	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
State Penitentiary, Ky	Cumberland River	43.7	1,600	None	1,600	1,600
Clarksville, Tenn	do	126.8	7,100	do	7,200	7,200
State Penitentiary, Tenn	do	182.4	2,100	do	2,500	2,500
Nashville, Tenn	do	193.7	117,000	do	274,500	274,500
Old Hickory, Tenn	do	219.5	8,500	Secondary	80,500	73,300
Pineville, Ky	do	636.2	2,700	None	2,700	2,700
Princeton, Ky	Eddy Creek	63	4,200	Primary	4,500	2,900



LEGEND

Indicates pollution removed by treatment.

Navigation Dam

FIGURE—C2
CUMBERLAND RIVER
SOURCES OF POLLUTION
AND
SELECTED LABORATORY DATA
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE

TABLE C-3.—*Cumberland Rioer Basin: Sources of significant pollution including industrial waste expressed as sewered population equivalent (biochemical ovygen demand*—Continued.

Municipality	Stream	Miles above mouth of Cumberland	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Western State Hospital, Ky.	South Fork Little River	106	2,100	Tank	2,100	2,100
Hopkinsville, Ky	North Fork Little River	106.5	10,300	Secondary	11,000	2,000
Springfield, Tenn	Sulfur Fork	160	3,300	do	5,700	2,800
Franklin, Tenn	Harpeth River	221.5	2,700	Tank	3,000	3,000
Central State Hospital, Tenn.	Mill Creek	203	2,000	Secondary	2,200	500
Murfreesboro, Tenn	West Fork Stones River	249	6,000	do	9,200	2,100
Gallatin, Tenn	East Fork Town Creek	243	2,000	do	2,500	400
Lebanon, Tenn	Sinking Creek	260.5	4,900	do	8,500	4,300
Cookeville, Tenn	Short Creek	358	3,700	None	3,700	3,700
McMinnville, Tenn	Barren Fork Creek	392	1,200	do	1,700	1,700
Somerset, Ky	Sinking Creek	522.5	4,000	Secondary	4,500	1,100
Corbin, Ky	Lynn Camp Creek	562.2	7,500	Tank	7,800	7,800
Middlesboro, Ky	Yellow Creek	653.5	9,000	Secondary	24,100	4,400
Lynch, Ky	Cooney Creek	694.3	8,000	None	8,000	8,000
Harlan, Ky	Martins Fork	670.5	5,000	Secondary	5,000	700
Small sources (37)			22,400	Various	23,300	21,400
Total:						
Kentucky			65,500		82,500	43,800
Tennessee			171,800		413,300	386,900
Total, basin			237,300		495,800	430,700

Industrial wastes.—Table C-4 summarizes pertinent information on 86 waste-producing industries in the basin. The manufacture of paper results in the greatest industrial waste pollution, followed in their order of importance by the manufacture of rayon and cellophane, meat packing, textile processing, and milk products. Included in the summary table, but with no attempt at evaluation, are certain wastes of an inert or chemical nature such as sand, gravel and coal washing, fertilizer wastes, etc. Approximately half of the industrial wastes are discharged into municipal sewerage systems, the remainder reach-the watercourses through private outlets. Thirty-one plants have taken steps to reduce pollution.

TABLE C-4.—*Cumberland River Basin: Summary of industrial wastes not discharging to municipal treatment plants, with total of entire industrial waste load in the basin.*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlet		
Canning	7	4	3	4	2,100
Chemical	2	0	2	0	72,000
Meat	5	2	3	3	37,500
Milk	25	18	7	9	9,600
Oil refining	3	0	3	3	1,200
Textile	8	4	4	0	9,000
Miscellaneous	18	5	13	4	109,200
Wastes unconnected municipal treatment	68	33	35	23	240,600
Wastes discharged to municipal treatment					17,900
Total industrial waste in the basin					258,500
By States:					
Kentucky					17,000
Tennessee					241,500

Presentation of Laboratory Data

Summaries of U. S. Public Health Service laboratory results for the Cumberland River Basin are presented in table C–7 p. 785. These data were obtained from operations of mobile laboratories connected with the present survey. Data for the Nashville area were collected by the Tennessee State Health Department in 1938–39. Mobile laboratories obtained data on other parts of the basin during the fall of 1940 and spring of 1941.

Selected average monthly analytical results at some of the principal points in the basin are tabulated with stream flows on sampling days and with the minimum flows of record in table C–5. Selected results have been chosen for low dissolved oxygen or high coli findings and, in general, represent the most unfavorable conditions during the sampling period.

Table C–5.—*Cumberland River Basin: Selected laboratory data*

River	Cumberland	Cumberland	Cumberland	Cumberland	Cumberland	Cumberland	Cumberland
Location	Mouth	At Canton, Ky.	Above Clarksville	Below Richland Creek	Above Richland Creek	Below Nashville	Above Nashville
River miles above mouth of Cumberland.	2.8	63	127	158.1	182.7	188.5	193.6
Period, 1940	September	November	November	1938–39 *	1938–39 *	1938–39 *	1938–39 *
Number of samples	4	3	3	25	18	14	17
Flow in cubic feet per second:							
Sampling days	1,530	3,997	3,020	[1] 515	[1] 648	[1] 575	[1] 643
Minimum month			1,100				766
Water temperature, °C	21.8	2.8	5.8	[2] 19.5	[2] 26	[2] 23.9	[2] 25.5
Coliforms per milliliter	1	19	50	[3] 127	[3] 974		
Dissolved oxygen, parts per million	7.8	10.2	8.1	[4] 1.7	[4] 3.1	[4] 0.1	[4] 5.6
Biochemical oxygen demand, 5-day, parts per million	1.5	1.2	2.5	[5] 5.6	[5] 5.4	[5] 6.2	[5] 5.0

River	Cumberland	Cumberland	Cumberland	Cumberland	Cumberland	Cumberland	Cumberland
Location	Above Stones River	Above duPont Plants	Rowena Ferry	Above Burnside	Above Cumberland Falls	Above Williamsburg	Below Pineville
River miles above mouth of Cumberland.	206	217.9	464	517	554	579	636
Period, 1940	1938–39 *	1938–39 *	September	September	September	September	September
Number of samples	14	13	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	[1] 480	[1] 515	397	227	107	88	170
Minimum month		903		84	23		12
Water temperature, °C	[2] 18.5	[2] 25	14.8	13.7	16.5	21.8	24.2
Coliforms per milliliter		[3] 87.5	9	2	2	3	64
Dissolved oxygen, parts per million	[4] 3.8	[4] 7.3	7.8	8.8	8.1	9.1	7.7
Biochemical oxygen demand, 5-day, parts per million	[5] 3.3	[5] 6.5	1.4	1.1	1.2	.8	.6

[1] Minimum day.
[2] Average.
[3] Average summer.
[4] Minimum.
[5] Maximum.

*Data from Tennessee Department of Health.

TABLE C–5.—*Cumberland River Basin: Selected laboratory data*—Continued

River	Little	North fork, Little	Sulfur Creek	Harpeth	Mill Creek	West Fork, Stone	Barton Creek
Location	Below Hopkinsville, Ky.	Above Hopkinsville, Ky.	Below Springfield, Tenn.	Below Franklin, Tenn.	Below State Hospital	Below Murfreesboro	Below Lebanon
River miles above—							
Confluence with Cumberland.	40	49	35	68	3	42	7
Mouth of Cumberland	98	107	161	221	197	248	259
Period	November 1940	November 1940	November 1940	January 1941	January 1941	January 1941	January 1941
Number of samples	3	3	3	4	4	4	4
Flow in cubic feet per second:							
Sampling days	7	2	14	107	21	136	75
Water temperature, °C	4.3	4.8	1.7	6.8	6.5	7.4	8.1
Coliforms per milliliter	377	236	2,270	675	783	31	349
Dissolved oxygen, parts per million	7.8	3.7	9.2	11.6	12.4	12.2	8.5
Biochemical oxygen demand, 5-day, parts per million	3.6	5.9	5.7	4.4	2.8	3.4	8.4

River	Barton Creek	Barren Fork	Barren Fork	Yellow Creek	Poor Fork	Poor Fork	Poor Fork
Location	Above Lebanon, Tenn.	Above McMinnville, Tenn.	Below McMinnville, Tenn.	Below Middlesboro, Ky.	Above Cumberland, Ky.	Below Cumberland, Ky.	Above Harlan, Ky.
River miles above—							
Confluence with Cumberland.	9	84	83	11	22	19	1
Mouth of Cumberland	261	393	392	652	691	688	670
Period	January 1941	February 1941	February 1941	September 1940	September 1940	September 1940	September 1940
Number of samples	4	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	24	12	111	9	21	33	59
Water temperature, °C	10.3	6.5	6.7	21.5	20.3	20.8	22.3
Coliforms per milliliter	285	([6])	33	17,000	209	1,030	14
Dissolved oxygen, parts per million	8.7	11.2	11.8	.9	6.8	7.4	8.2
Biochemical oxygen demand, 5-day, parts per million	2.8	2.4	2.7	7.8	1.8	1.9	.9

[6] Less than 1.

Figures C–3, C–4, and C–5 show graphically, by spot map symbols, the concentration of coliform organisms, dissolved oxygen and oxygen demand, respectively, at various sampling points throughout the watershed. These data are presented as averages of all the results where the sampling period was less than a month. At points sampled by the Tennessee State Department of Health, where sampling extended over longer periods, data are presented as the most unfavorable averages during periods of minimum stream flow.

Stream flows during the period of mobile laboratory observations were generally in the lower discharge ranges, except in eastern Kentucky where local rains influenced the discharges and analytical results during the latter part of August 1940. Data furnished by the Tennessee State Health Department were collected over a 12-month period and a wide variety of flows was encountered.

As indicated by bacteriological findings, about 76 percent of the sampling stations not immediately below sources of pollution showed maximum coliform organism concentrations of less than 200 per milliliter. In general, conditions were worse on the tributary streams than on the main river.

Dissolved oxygen results show the main river to be in good sanitary condition except below Old Hickory and Nashville. The average dissolved oxygen below Nashville reached a minimum of 2.1 parts per million and did not recover to a value of 5.0 parts per million or better within a 30-mile zone. The dissolved oxygen along the remaining portions of the main river and on many of the tributaries was in excess of 6.5 parts per million. The worst conditions along the tributary streams occurred below London, Ky., and Oneida, Tenn., where total oxygen depletion was observed. Dissolved oxygen values of less than 3.0 parts per million were also observed below Corbin, Middlesboro, Mount Vernon, Hopkinsville, and Princeton, Ky.

Stream sampling reported by the Tennessee State Department of Public Health, but not detailed in the present report, have shown dissolved oxygen results of 2.0 parts per million or less below the following Tennessee towns: Gallatin, Lebanon, Murfreesboro, Franklin, and Dickson. The oxygen demand results were generally in agreement with the dissolved oxygen findings in revealing points of pollution. High average demands of between 75 and 205 part per million were recorded at Jellico and Oneida, Tenn., and at London, Corbin, Mount Vernon, and Princeton, Ky. Average demands of 10 to 20 parts per million were observed at Lynch, Ky., and Dickson and Gallatin, Tenn., and averages of 5 to 10 parts per million were found at Middlesboro, Guthrie, and Hopkinsville, Ky., and at Cookeville, Springfield, Woodbury, and Lebanon, Tenn.

Coal washing operations produced a bad appearance in the waters of Fugitt Creek, Clover Fork, Clear Fork, and Hickory Creek. No acid stream conditions were observed on any of the streams in the coal-mining areas of eastern Kentucky at the time of this survey.

Evidence of active self-purification in the streams was shown by reduction in coliform counts and in oxygen demand values along some of the tributaries and along the main stream below Nashville. The water quality on Poor Fork above Harlan was good despite considerable pollution from mining camps upstream. Results at the mouths of streams as compared with the results below sources of pollution farther upstream in general indicated betterment in water quality. The results at Nashville tended to show that the coliform counts do not diminish rapidly under high discharge conditions and lower temperatures and persist for longer distances downstream below sources of pollution.

Biological summary.—The Cumberland has a low plankton volume of less than 2,000 parts per million except below Nashville, where the fertilizing effect of its sewage increases the plankton volume to 8,000 parts per million. This stream shows very nicely the effect of domestic pollution on plankton. Fish collecting was difficult and generally small catches were obtained.

Fig. C-3

GREEN — CUMBERLAND BASINS

COLIFORM RESULTS

10 0 10 20 30
SCALE OF MILES

FIG. C-3
LEGEND
Average Coliform Results
Sampling Stations

Symbol	Most probable number per ml
○	Under 25
◔	26-50
◑	51-100
◕	101-200
●	Over 200
⊢○	Tennessee Health Department Data

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 780)
No. 1 GPO-43 0-9035

Fig. C-3

Fig C-4

Fig. C-4

GREEN — CUMBERLAND BASINS

DISSOLVED OXYGEN RESULTS

10 0 10 20 30
SCALE OF MILES

FIG. C-4

LEGEND

Average Dissolved Oxygen Results of Sampling Stations.

Symbol	Dissolved Oxygen p.p.m
○	Over 6.5
◔	5.1 to 6.5
◑	3.1 to 5.0
●	0.1 to 3.0
◉	0.0
T○	Tennessee Health Department Data

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 780) No. 2 GPO-43 O-90035

Fig. C-5

GREEN — CUMBERLAND BASINS

BIOCHEMICAL OXYGEN DEMAND

FIG. C-5
LEGEND
Average B.O.D. Results at Sampling Stations.

Symbol (Normal Samples)	p.p.m.	Acid Stream Samples (Neutralized & Seeded)
○	0.0 to 3.0	◎
◐	3.1 to 5.0	
●	Over 5.0	
I—○	Tennessee Health Department Data.	

SCALE OF MILES: 10 0 10 20 30

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

(Face p. 780) No. 3 GPO-43 0-8035

Fig. C-5

HYDROMETRIC DATA

Forty-eight stream-gaging stations have been maintained on the Cumberland River Basin for varying periods, 25 of which are active at the present time. Eight stations of importance from a pollution standpoint have been selected and the monthly mean summer flows for the 3 years in which the lowest summer flows have occurred are presented in table C–6.

TABLE C–6.—*Cumberland River Basin: Monthly mean summer flows for years in which lowest summer flows have occurred*

River	Cumberland	Cumberland	Cumberland	Obey
Location	Clarksville, Tenn.	Nashville, Tenn.	Old Hickory, Tenn.	Byrdstown, Tenn.
River miles above—				
Confluence with Cumberland				45.2
Mouth of Cumberland	126.5	191.1	218.2	426.1
Drainage area (square miles)	14,370	12,750	11,610	425
Period of record	1922–40	1888–1931	1931–40	1919–40
Year	1925	1899	1932	1925
June ... cubic feet per second	4,640	4,640	4,850	86
July ... do	4,490	3,640	16,300	45
August ... do	1,510	3,350	2,510	20
September ... do	1,100	1,180	1,910	64
Year	1936	1913	1936	1930
June ... cubic feet per second	2,119	8,650	1,086	67
July ... do	6,979	2,350	2,835	30
August ... do	2,012	2,000	924	30
September ... do	1,375	905	903	22
Year	1939	1925	1939	1936
June ... cubic feet per second	10,670	3,820	7,193	37
July ... do	8,764	3,570	7,263	31
August ... do	5,635	1,200	3,748	[1] 19
September ... do	[1] 1,099	[1] 796	[1] 889	33
River	Caney Fork	Stone	Harpeth	Red
Location	Silver Point, Tenn.	Smyrna, Tenn.	Kingston Springs, Tenn.	Adams, Tenn.
River miles above—				
Confluence with Cumberland	41.6	25	32.4	32.9
Mouth of Cumberland	350.8	231	185.3	158.4
Drainage area (square miles)	2,130	550	695	690
Period of record	1923–40	1925–40	1925–40	1920–40
Year	1924	1925	1931	1925
June ... cubic feet per second	2,057		96	370
July ... do	1,082		122	172
August ... do	528	20	74	83
September ... do	361	[1] 8	32	61
Year	1925	1930	1935	1936
June ... cubic feet per second	920	124	264	115
July ... do	627	32	358	315
August ... do	528	36	113	165
September ... do	[1] 289	33	45	78
Year	1936	1935	1936	1939
June ... cubic feet per second	339	406	61	409
July ... do	1,677	183	349	205
August ... do	366	134	69	265
September ... do	352	25	31	65

[1] Minimum month.

Fig. C-6

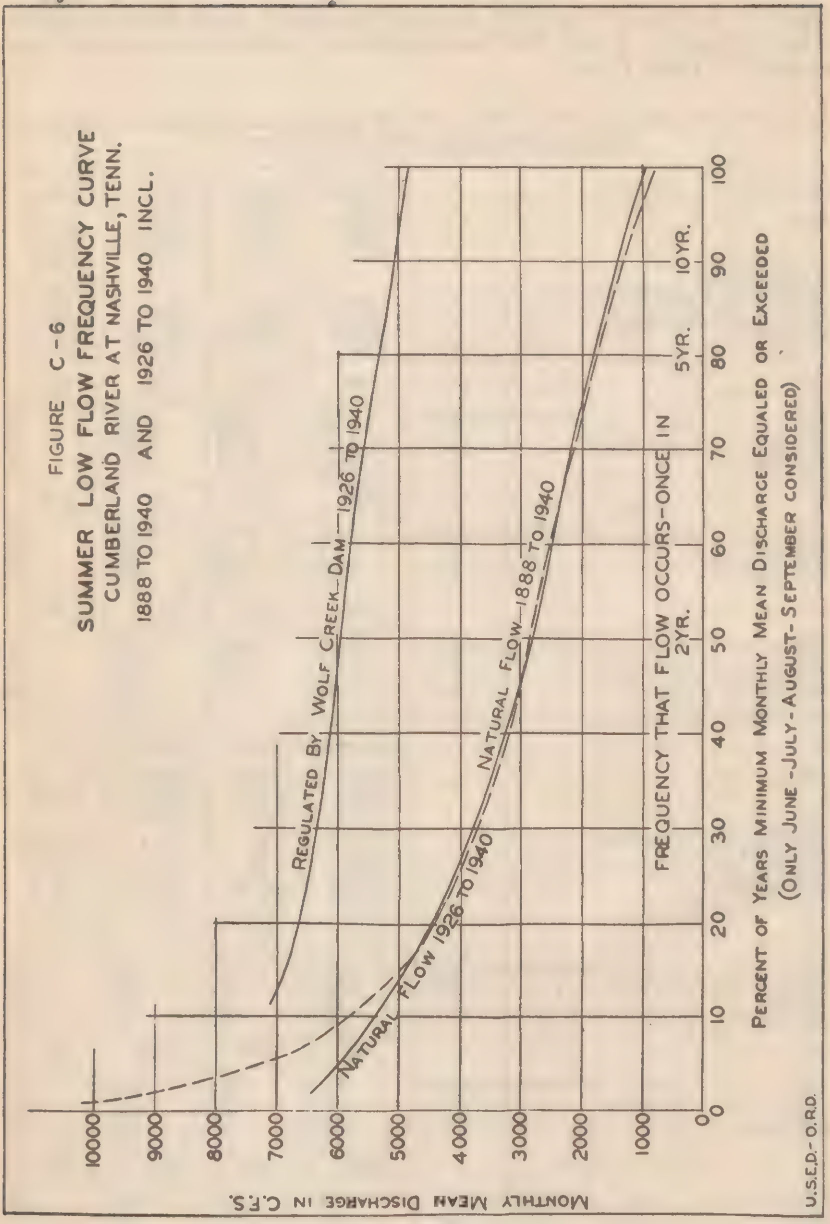


FIGURE C-6
SUMMER LOW FLOW FREQUENCY CURVE
CUMBERLAND RIVER AT NASHVILLE, TENN.
1888 TO 1940 AND 1926 TO 1940 INCL.
REGULATED BY WOLF CREEK DAM—1926 TO 1940
NATURAL FLOW—1888 TO 1940
NATURAL FLOW 1926 TO 1940
FREQUENCY THAT FLOW OCCURS—ONCE IN
2YR.
5YR.
10YR.
MONTHLY MEAN DISCHARGE IN C.F.S.
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF YEARS MINIMUM MONTHLY MEAN DISCHARGE EQUALED OR EXCEEDED
(ONLY JUNE-JULY-AUGUST-SEPTEMBER CONSIDERED)
U.S.E.D.-O.R.D.

Figure C–6 presents a low-flow frequency curve of the minimum monthly mean flows from June to September, inclusive, for the Cumberland River at Nashville. This curve is based, necessarily, upon past records and will not reflect conditions that may be expected when low-flow control works, now under construction, are completed. The curve indicates that the expectancy of low monthly mean summer flows is as follows:

Location	Minimum monthly mean summer flows in cubic feet per second that may be expected once in—			
	2 years	5 years	10 years	Minimum
Nashville	2,800	1,700	1,300	750

Low-flow regulation.—The Wolf Creek Reservoir in the Cumberland Basin is being constructed by the United States Engineer Department in connection with the authorized program for Ohio River flood control. The reservoir will have a maximum storage capacity of more than 5,000,000 acre-feet and will provide a minimum flow of 4,800 cubic feet per second at Nashville. Two additional flood-control and power reservoirs, Dale Hollow on Obey River and Center Hill on Caney Fork River, are also under construction. These should increase further the minimum flow at Nashville.

A proposed reservoir on the Poor Fork River, a headwater tributary of the Cumberland, might be expected to benefit the water and sewerage works of the town of Cumberland, Ky. A minimum flow of 10 to 15 cubic feet per second would be available from this reservoir.

Discussion

The only pollution problem of serious consequence found in the Cumberland River Basin is in the Nashville area. Minor pollution of local significance occurs at a number of smaller communities on minor streams. Corrective measures at these points are included in the cost estimates but discussion has been omitted.

The Tennessee State Health Department has made detailed studies of the Cumberland River in the vicinity of Nashville and is preparing a report thereon. The results of their observations have been available for this report and have been freely used. Grateful appreciation is expressed for this courtesy.

NASHVILLE AND VICINITY

The 40 miles of the Cumberland River from Old Hickory to below Nashville, Tenn., receives waste from an equivalent sewered population of 353,000, about 80 percent of the basin's total pollution load. The only effective sewage treatment in this area is at Old Hickory where the domestic sewage receives secondary treatment.

As a consequence of this pollution, conditions in the river below Nashville are definitely bad during periods of low flow. Bacteriological studies show the water to be unsuitable as a source of raw water for a public supply from Nashville downstream to Clarksville, a

distance of sixty-odd miles, and the river water in this area does not meet the swimming water standard (0.5 per milliliter) recommended by the Tennessee Public Health Council.

Analytical studies of oxygen conditions below Nashville show dissolved oxygen values as low as 0.1 parts per million and oxygen demands as high as 6.6 parts per million. Scum and floating material are observed on the water, which detracts from riparian values. Sludge blankets the stream bed for a distance of 18 miles below Nashville, preventing the propagation of fish and increasing the oxygen depletion.

At Nashville, monthly mean summer flows (June to November) have been less than 2,000 cubic feet per second during 23 of the 44 years of record and less than 1,000 cubic feet per second during 10 of these years. With primary treatment of the present wastes discharged to the river in the vicinity of Nashville, a minimum flow of 1,500 to 2,000 cubic feet per second is desirable for dilution, the quantity depending in part on the effect of upstream pollution. Lacking this quantity of dilution water, more refined methods of waste treatment would be necessary.

The Wolf Creek Reservoir, now under construction on the Cumberland River at mile 460.9, will furnish minimum summer flows at Nashville of an estimated 4,800 cubic feet per second as ultimately developed. Under these circumstances, primary treatment of sewage and equivalent treatment of industrial wastes at Nashville and Old Hickory will be adequate. The minimum tangible monetary benefit of the increase in low flow, computed as equivalent to savings in treatment cost in the Nashville area, amounts to $50,000 annually. Other benefits, that are highly desirable but incapable of invoice in dollars, are:

(1) Higher dissolved oxygen residuals in the vicinity of Nashville, improving the stream as a habitat for aquatic life.

(2) Dilution for potential increases in pollution loads.

Cost estimates for remedial measures for pollution abatement suggested, as justified by the stream uses, are summarized on table C–1.

TABLE C-7.—*Cumberland River Basin: Ohio River pollution survey laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature °C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
Poor Fork, above Cumberland, Ky	CPf 691	Aug. 28, 1940	21	22.0	6.3	71.3	0.6	75	7.3	7	54	
Do	do	Sept. 4, 1940	21	18.5	7.3	77.3	1.0	93	7.3	8	48	26
Do	do	Sept. 10, 1940	21	20.5	6.8	74.9	3.7	460	7.6	35	80	
Looney Creek, ¼ mile above Lynch, Ky.	CPfL 696	Aug. 28, 1940	2	20.5	8.3	91.4	.6	46	7.7	7	80	
Do	do	Sept. 4, 1940	5	16.5	9.4	95.9	.5	9	7.4	10	50	26
Do	do	Sept. 10, 1940	4	19.0	8.5	91.8	1.8	1,100	7.6	80	70	
Looney Creek, below city limits, Lynch, Ky.	CPfL 694	Aug. 28, 1940	4	20.0	4.2	45.9	17.2	4,300	7.9	15	336	
Do	do	Sept. 4, 1940	8	17.0	7.8	79.6	20.1	4,600	7.8	25	152	52
Do	do	Sept. 10, 1940	6	19.5	5.3	57.0	19.8	4,600	7.8	50	242	
Looney Creek, mouth Cumberland, Ky.	CPfL 691	Aug. 28, 1940	10	21.0	8.4	93.4	4.3	430	8.1	10	236	
Do	do	Sept. 4, 1940	14	17.0	9.4	96.5	2.8	930	8.1	5	156	66
Do	do	Sept. 10, 1940	11	19.5	7.0	75.8	6.4	910	7.7	60	182	
Poor Fork, 1 mile below Cumberland, Ky.	CPf 688	Aug. 28, 1940		22.5	7.7	88.0	1.2	240	7.8	7	104	
Do	do	Sept. 4, 1940		19.5	8.0	86.8	1.2	460	7.4	5	52	30
Do	do	Sept. 10, 1940		20.5	6.5	71.7	3.4	2,400	7.6	95	104	
Poor Fork, water plant intake above Harlan, Ky.	CPf 670	Aug. 27, 1940	71	26.0	8.3	101.0	1.0	9	7.5	5	60	40
Do	do	Sept. 3, 1940	76	21.0	8.7	97.2	1.0	9	7.3	13		52
Do	do	Sept. 9, 1940	31	20.0	7.6	82.7	.8	24	7.7	5	84	
Clover Fork, above Closplint, Ky	CClF 688	Aug. 29, 1940	10	21.5	8.4	94.3	.8	23	7.3	5	28	
Do	do	Sept. 5, 1940	14	18.5	8.8	93.2	.7	93	7.2	5	28	
Do	do	Sept. 11, 1940	12	13.5	9.0	85.9	.9	43	7.2	5	36	38
Fugitt Creek, at mouth	CClfF 687	Aug. 29, 1940	1	21.0	8.4	93.2	.8	150	7.7	100	104	
Do	do	Sept. 5, 1940	2	18.5	9.0	95.2	.8	43	7.7	20	104	52
Do	do	Sept. 11, 1940	2	13.5	9.4	89.3	2.1	240	7.8	50	112	
Clover Fork, below Louellen, Ky	CClf 685	Aug. 29, 1940	12	21.0	8.0	88.7	.9	93	7.3	5	42	
Do	do	Sept. 5, 1940	16	18.0	8.9	92.9	.8	150	7.3	8	36	42
Do	do	Sept. 11, 1940	14	13.5	9.1	86.8	.8	240	7.4	10	42	
Clover Fork, ¼ mile above Evarts, Ky.	CClf 679	Aug. 29, 1940	18	22.5	7.8	89.1	1.0	240	7.4	8	40	
Do	do	Sept. 5, 1940	22	19.0	8.3	88.6	.7	43	7.3	8	36	56
Do	do	Sept. 11, 1940	19	13.5	8.4	80.0	1.0	150	7.3	25	36	
Yocum Creek, at mouth	CClfY 679	Aug. 29, 1940	4	22.5	8.8	100.6	1.2	240	7.7	8	104	
Do	do	Sept. 5, 1940	12	19.5	10.0	108.2	1.2	93	8.2	5	96	88
Do	do	Sept. 11, 1940	4	13.5	9.0	85.4	1.9	1,100	7.7	8	106	

TABLE C-7.—*Cumberland River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Clover Fork, ¼ mile below Evarts, Ky.	CClf 677	Aug. 29, 1940	22	23.0	8.6	98.5	1.1	930	7.5	5	44	
Do	do	Sept. 5, 1940	33	20.5	9.1	99.9	1.9	93	7.4	5	38	62
Do	do	Sept. 11, 1940	23	14.0	9.2	89.2	2.1	460	7.3	25	34	
Clover Fork, above Harlan, Ky	CClf 672	Aug. 28, 1940	24	24.5	8.3	98.6	.6	93	7.6	5	50	
Do	do	Sept. 3, 1940	52	20.0	8.7	94.9	.7	93	7.5	8	40	44
Do	do	Sept. 9, 1940	19	19.0	6.8	72.4	.8	39	7.6	5	56	
Martin's Fork, mouth above city limits, Harlan, Ky.	CClfM 672	Aug. 28, 1940	12	25.0	7.6	90.3	1.1	24	7.6	5	68	
Do	do	Sept. 3, 1940	30	20.0	8.3	90.1	.7	36	7.6	10	50	38
Do	do	Sept. 9, 1940	11	19.0	7.7	82.1	1.1	43	7.4	8	70	
Cumberland River, ½ mile below Harlan, Ky.	C 669	Aug. 27, 1940	106	26.5	7.0	86.6	1.3	75	7.4	7	68	46
Do	do	Sept. 3, 1940	82	18.0	8.0	83.4	1.4	43	7.4	13	48	
Do	do	Sept. 9, 1940	30	19.5	5.6	60.4	.8	93	7.3	8	62	
Cumberland River, below Loyall, Ky.	C 654	Aug. 27, 1940		26.5	5.8	70.9	1.4	460	7.4	10	58	46
Do	do	Sept. 3, 1940		18.0	6.9	72.1	.8	240	7.3	15	46	
Do	do	Sept. 9, 1940		19.5	7.1	76.3	1.0	93	7.8	10	70	
Puckett Creek, mouth, railroad bridge, Cardinal, Ky.	CP 654	Aug. 27, 1940	3	25.5	5.2	62.7	1.4	1,100	7.5	45	90	104
Do	do	Sept. 3, 1940	3	17.5	7.3	75.7	.9	23	7.6	13	82	
Do	do	Sept. 9, 1940	1	19.0	7.0	75.1	1.2	23	7.6	8	92	
Cumberland River, bridge on Route No. 72, Cardinal, Ky.	C 653	Aug. 27, 1940	154	29.0	7.6	97.6	.8	2	7.3	8	46	42
Do	do	Sept. 3, 1940	219	18.5	7.7	81.1	.7	23	7.3	15	44	
Do	do	Sept. 9, 1940	67	19.0	7.3	78.2	.6	15	7.7	5	60	
Yellow Creek, bridge above lake, Middlesboro, Ky.	CY 655	Aug. 27, 1940	2	21.0	6.6	73.4	.4	43	7.2	12	64	148
Do	do	Aug. 30, 1940	15	22.0	7.7	86.9	.9	1,100	7.4	20	58	
Do	do	Sept. 6, 1940	2	19.0	6.7	71.4	.6	23	7.6	10	56	
Yellow Creek, railroad bridge, 1 mile below Middlesboro.	CY 652	Aug. 27, 1940	6	23.0	.4	4.6	10.6	46,000	7.1	35	100	100
Do	do	Aug. 30, 1940	14	22.5	.7	8.3	8.2	4,300	7.2	65	88	
Do	do	Sept. 6, 1940	5	19.0	1.7	17.8	4.6	910	7.2	65	94	
Cumberland River, ¼ mile above Pineville, Ky.	C 637	Aug. 26, 1940	174	26.5	7.7	95.0	.9	46	7.3	8	36	40
Do	do	Aug. 30, 1940	181	24.0	7.4	87.3	.5	4	7.5	5	46	
Do	do	Sept. 6, 1940	137	20.5	7.5	83.0	.4	2	7.7	15	46	

Straight Creek, ¼ mile above mouth	CS 637	Aug. 26, 1940	7	26.5	8.2	100.4	.9	75	7.3	5	54	52
Do	do	Aug. 30, 1940	13	24.0	7.5	88.2	.6	43	7.6	5	70	----------
Do	do	Sept. 6, 1940	4	20.0	7.1	77.1	.5	23	7.5	5	56	----------
Cumberland River, below Pineville, Ky.	C 636	Aug. 26, 1940	181	26.5	7.9	97.1	.7	93	7.3	8	42	38
Do	do	Aug. 30, 1940	194	24.5	7.5	88.8	.4	93	7.5	5	50	----------
Do	do	Sept. 6, 1940	141	21.5	7.6	85.4	.7	7	7.5	8	46	----------
Cumberland River, above Barboursville, Ky.	C 625	Aug. 26, 1940	242	25.5	7.2	87.3	.7	43	7.2	15	42	38
Do	do	Aug. 30, 1940	165	27.5	7.4	92.2	.4	39	7.5	8	40	----------
Do	do	Sept. 6, 1940	164	23.0	7.1	81.8	.9	9	7.6	5	62	----------
Brush Creek, above mouth	CB 625	Aug. 26, 1940	(1)	24.0	6.2	72.9	1.5	4	6.9	12	48	120
Do	do	Aug. 30, 1940	3	27.5	5.1	64.2	1.9	240	7.0	10	64	----------
Do	do	Sept. 6, 1940	1	23.5	6.7	78.0	1.0	460	7.3	15	60	----------
Cumberland River, below mouth, Richland Creek.	C 620	Aug. 26, 1940	242	24.5	7.2	85.8	1.7	8	7.0	5	36	36
Do	do	Aug. 30, 1940	168	27.0	7.6	94.2	1.6	110	7.3	8	42	----------
Do	do	Sept. 6, 1940	164	25.5	7.9	95.1	1.4	240	7.7	5	60	----------
Clear Fork, below Anthras, Tenn	CCf 605	Sept. 13, 1940	1	12.0	7.9	72.9	1.7	9	7.7	12	76	178
Do	do	Sept. 18, 1940	(1)	14.0	7.2	69.2	.9	15	7.5	13	70	----------
Do	do	Sept. 23, 1940	(1)	19.0	5.8	62.0	1.1	43	7.4	10	90	----------
Hickory Creek, below Morley, Tenn	CCfH 604	Sept. 13, 1940	2	11.5	9.6	87.6	1.0	23	7.5	130	64	72
Do	do	Sept. 18, 1940	1	14.0	7.2	69.4	4.4	15	7.7	250	72	----------
Do	do	Sept. 23, 1940	(1)	19.0	7.1	75.9	2.2	46	7.6	240	68	----------
Clear Fork, 5 miles south of Jellico, Tenn.	CCf 602	Sept. 13, 1940	4	11.0	8.7	78.5	.8	4	7.5	10	44	76
Do	do	Sept. 18, 1940	2	16.0	7.9	79.4	.8	2	7.6	10	50	----------
Do	do	Sept. 23, 1940	1	18.5	6.8	72.0	1.3	46	7.5	8	54	----------
Elk Creek, above Jellico City, Tenn	CCfE 598	Sept. 13, 1940	1	13.5	6.5	62.3	5.9	43	7.7	15	168	110
Do	do	Sept. 18, 1940	1	17.0	5.2	53.5	1.4	240	7.7	15	188	----------
Do	do	Sept. 23, 1940	(1)	18.5	3.3	35.1	1.2	9	7.6	10	220	----------
Elk Creek, ¼ mile below Jellico City, Tenn.	CCfE 597	Sept. 13, 1940	1	14.0	2.0	18.8	57.4	4,300	7.5	10	180	106
Do	do	Sept. 18, 1940	1	17.5	1.7	17.5	544	930	7.4	10	192	----------
Do	do	Sept. 23, 1940	(1)	19.0	.9	9.2	16.4	430	7.6	10	222	----------
Clear Fork, above mouth, Williamsburg, Ky.	CCf 582	Sept. 13, 1940	7	15.5	8.0	80.1	1.2	4	7.5	12	58	72
Do	do	Sept. 18, 1940	4	21.0	7.9	87.7	.8	4	7.6	15	56	----------
Do	do	Sept. 23, 1940	2	21.5	7.0	78.6	.3	9	7.5	13	64	----------
Cumberland River water plant intake above Williamsburg, Ky.	C 579	Sept. 13, 1940	130	18.5	9.2	97.7	.8	4	7.7	7	56	52
Do	do	Sept. 18, 1940	83	23.0	9.4	108.3	1.3	2	7.9	8	58	----------
Do	do	Sept. 23, 1940	52	24.0	8.7	102.0	.4	4	7.7	5	54	----------
Cumberland River, ¼ mile below Williamsburg, Ky.	C 577	Sept. 13, 1940	130	18.0	8.6	90.6	.7	93	7.6	10	60	54
Do	do	Sept. 18, 1940	83	22.5	8.4	96.3	2.0	240	7.6	15	62	----------
Do	do	Sept. 23, 1940	52	22.5	6.8	78.1	1.6	150	7.4	5	54	----------
Cumberland River, above Cumberland Falls, Ky.	C 554	Sept. 17, 1940	130	14.5	8.5	83.0	1.6	1	7.7	8	50	48
Do	do	Sept. 20, 1940	92	19.0	8.0	85.9	1.2	2	7.6	5	54	----------
Do	do	Sept. 25, 1940	100	16.0	7.6	76.7	.9	4	7.6	8	54	----------

[1] Less than 1. [2] Seeded and neutralized.

TABLE C-7.—*Cumberland River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Cumberland River, below Cumberland Falls, Ky.	C 552	Sept. 17, 1940	130	14.0	8.6	83.2	1.4	9	7.6	5	48	50
Do	do	Sept. 20, 1940	92	20.0	8.2	89.4	1.0	2	7.7	5	48	
Do	do	Sept. 25, 1940	100	15.5	7.5	74.9	.9	9	7.5	10	58	
King branch, Laurel River, below London, Ky.	CLLiK 577	Sept. 16, 1940	(1)	20.0	0	0	71.6	460,000	7.4	140	568	78
Do	do	Sept. 19, 1940	(1)	26.5	0	0	737.0	93,000	7.2	210	550	
Do	do	Sept. 24, 1940	(1)	26.0	0	0	186.0	240,000	7.2	180	442	
Town Branch, Laurel River, below London, Ky.	CLLiT 576	Sept. 16, 1940	(1)	21.0	0	0	783.0	240,000	7.3	130	552	92
Do	do	Sept. 19, 1940	(1)	26.5	0	0	404.0	23,000	8.3	200	558	
Do	do	Sept. 24, 1940	(1)	25.0	0	0	670.0	230,000	7.1	260	496	
Little Laurel River, 4 miles below London, Ky.	CLLi 572	Sept. 16, 1940	(1)	21.0	6.4	71.2	2.4	93	7.1	25	40	30
Do	do	Sept. 19, 1940	(1)	27.0	5.8	72.2	2.6	15	7.1	50	48	
Do	do	Sept. 24, 1940	(1)	24.5	5.7	67.7	2.9	150	7.1	35	42	
Lynn Camp Creek, above Corbin, Ky.	CLLc 563	Sept. 17, 1940	(1)	14.5	4.3	41.7	2.3	9	6.9	75	34	30
Do	do	Sept. 20, 1940	(1)	16.0	4.0	39.9	5.3	9	6.7	70	30	
Do	do	Sept. 25, 1940	(1)	16.5	4.9	49.5	3.3	240	7.3	65	32	
Lynn Camp Creek, below Corbin, Ky.	CLLc 562	Sept. 17, 1940	1	17.0	0	0	20.0	230,000	7.3	65	252	72
Do	do	Sept. 20, 1940	1	15.5	0	0	155.0	240,000	7.1	80	240	
Do	do	Sept. 25, 1940	1	19.0	1.2	12.4	53.2	23,000	6.9	250	88	
Laurel River, Barton's Mills, Ky	CL 556	Sept. 17, 1940	1	13.0	7.4	69.8	1.5	2	7.4	10	44	30
Do	do	Sept. 20, 1940	1	17.0	7.3	74.6	1.1	46	7.6	15	98	
Do	do	Sept. 25, 1940	4	17.0	6.6	68.2	1.9	46	7.6	15	102	
Town Branch, above Mount Vernon, Ky.	CRRcT 594	Sept. 16, 1940	(1)	16.0	9.0	90.4	2.4	4	8.1	15	114	98
Do	do	Sept. 19, 1940	(1)	18.0	9.2	96.9	2.7	1	8.1	8	110	
Do	do	Sept. 24, 1940	(1)	21.5	9.8	110.0	2.0	1	8.1	15	106	
Town Branch, below Mount Vernon, Ky.	CRRcTb 591	Sept. 16, 1940	(1)	15.0	3.8	37.7	29.5	15,000	7.5	20	224	180
Do	do	Sept. 19, 1940	(1)	17.5	2.8	29.0	71.7	23,000	7.5	15	226	
Do	do	Sept. 24, 1940	(1)	21.5	1.1	12.2	26.6	75,000	7.5	13	234	
Roundstone Creek, below Withers, Ky.	CRo 584	Sept. 16, 1940	6	15.0	7.8	77.2	1.5	23	7.6	20	112	78
Do	do	Sept. 19, 1940	4	18.0	7.9	82.6	2.0	46	7.7	10	114	
Do	do	Sept. 24, 1940	3	21.0	6.8	76.0	.6	15	7.7	15	118	

Rockcastle River, below Livingston, Ky.	CR 578	Sept. 16, 1940	16	16.5	7.8	79.2	1.2	4	7.5	20	78	74
Do	do	Sept. 19, 1940	10	20.5	7.8	85.9	1.6	46	7.5	13	82	
Do	do	Sept. 24, 1940	4	23.0	7.9	91.5	1.0	4	7.6	15	84	
Rockcastle River, bridge on London to Somerset Road.	CR 566	Sept. 16, 1940	28	19.5	8.4	90.9	1.5	4	7.7	10	78	80
Do	do	Sept. 19, 1940	20	25.0	8.1	97.0	2.2	2	7.8	10	90	
Do	do	Sept. 24, 1940	12	25.0	8.1	96.2	.8	9	7.7	10	84	
Buck Creek, East Somerset, Ky	CB 548	Sept. 27, 1940	20	7.5	8.8	73.2	1.1	75	7.5	35	70	64
Do	do	Oct. 1, 1940	5	11.0	9.2	83.4	1.3	4	7.7	8	82	
Do	do	Oct. 3, 1940	3	12.0	9.4	86.3	.7	8	7.6	8	86	
Cumberland River, above Burnsides, Ky.	C 517	Sept. 26, 1940	190	15.0	8.4	82.8	1.0	4	7.5	5	50	46
Do	do	Sept. 30, 1940	240	12.5	8.9	83.5	.8	1	7.7	8	50	
Do	do	Oct. 2, 1940	250	13.5	8.9	84.9	1.4	1	7.8	8	54	
Pine Creek, above Oneida, Tenn	CSfP 590	Sept. 26, 1940	(1)	11.0	4.3	38.4	6.6.	11,000	7.1	320	46	42
Do	do	Sept. 30, 1940	(1)	19.5	9.4	101.6	3.8	30	7.5	20	58	
Do	do	Oct. 2, 1940	(1)	10.5	6.5	57.8	3.1	43	7.4	30	62	
Pine Creek, below Oneida, Tenn	CSfP 589	Sept. 26, 1940	(1)	11.0	0	0	61.6	43,000	6.5	260	88	80
Do	do	Sept. 30, 1940	(1)	20.0	0	0	191.0	43,000	7.5	110	192	
Do	do	Oct. 2, 1940	(1)	10.0	0	0	153.0	43,000	6.8	85	228	
South Fork, at Yamacraw	CSf 553	Sept. 26, 1940	130	11.5	7.9	72.1	.9	23	7.1	15	18	28
Do	do	Sept. 30, 1940	87	18.5	7.8	82.5	Broke	24	7.1	5	16	
Do	do	Oct. 2, 1940	61	9.5	8.1	70.9	1.1	4	7.0	5	18	
South Fork, mouth, Burnsides, Ky	CSf 517	Sept. 26, 1940	160	15.0	8.9	87.6	.6	9	7.3	8	28	26
Do	do	Sept. 30, 1940	120	12.5	9.1	84.6	.6	(1)	7.4	8	30	
Do	do	Oct. 2, 1940	92	14.0	9.1	87.4	1.0	4	7.5	5	32	
Pittman Creek, above Somerset, Ky	CPc 527	Sept. 27, 1940	2	9.0	8.4	72.1	2.0	460	7.5	100	90	88
Do	do	Oct. 1, 1940	(1)	11.5	8.0	73.4	1.4	9	7.6	35	114	
Do	do	Oct. 3, 1940	(1)	14.5	8.2	79.4	1.0	9	7.7	18	104	
Sinking Creek, below Somerset, at Ferguson.	CPcSc 520	Sept. 27, 1940	2	10.5	6.0	53.5	5.1	93	7.6	8	150	142
Do	do	Oct. 1, 1940	1	12.0	7.4	67.9	8.4	150	7.7	5	168	
Do	do	Oct. 3, 1940	1	12.5	6.0	56.3	8.2	93	8.1	15	124	
Cumberland River, below mouth of Pittman Creek, Burnsides, Ky.	C 515	Sept. 26, 1940	350	15.0	7.6	75.2	1.0	23	7.5	13	42	44
Do	do	Sept. 30, 1940	350	21.5	9.3	104.6	1.1	2	7.6	8	46	
Do	do	Oct. 2, 1940	350	19.0	8.9	95.6	1.0	1	7.6	8	46	
Fishing Creek, west of Somerset, Ky	CF 516	Sept. 27, 1940	15	16.0	9.1	91.5	1.6	93	7.6	25	86	86
Do	do	Oct. 1, 1940	6	18.5	9.0	95.8	1.2	4	7.7	10	72	
Do	do	Oct. 3, 1940	4	13.5	7.7	73.3	.7	43	7.7	8	88	
Elk Creek, above Monticello, Ky	CBeE 488	Sept. 26, 1940	3	14.0	10.1	97.7	1.5	240	7.8	10	120	120
Do	do	Sept. 30, 1940	1	14.5	12.3	119.5	.7	9	7.8	8	142	
Do	do	Oct. 2, 1940	1	17.0	10.5	108.2	1.9	93	7.9	15	142	
Elk Creek, below Monticello, Ky	CBeE 486	Sept. 26, 1940	3	15.0	10.4	102.9	1.7	230	7.7	5	156	144
Do	do	Sept. 30, 1940	1	13.5	9.5	91.0	1.9	240	7.7	8	154	
Do	do	Oct. 2, 1940	1	15.5	10.4	103.5	2.7	430	7.8	15	152	
Cumberland River, Rowena Ferry	C 464	Sept. 27, 1940	480	16.0	7.1	71.4	1.6	23	7.5	35	50	52
Do	do	Oct. 1, 1940	370	15.0	8.8	86.7	1.6	2	7.6	10	52	
Do	do	Oct. 3, 1940	340	13.5	8.1	77.2	.9	2	7.4	15	46	

[1] Less than 1.

TABLE C-7.—*Cumberland River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Cumberland River, above Burkesville, Ky.	C 428	Oct. 7, 1940	258	19.0	8.3	88.7	.9	1	7.6	10	56	54
Do	do	Oct. 11, 1940	187	13.5	8.7	83.0	4.8	(1)	7.5	13	60	
Do	do	Oct. 17, 1940	200	8.0	8.4	70.9	.5	2	7.4	5	56	
Cumberland River, below Burkesville, Ky.	C 426	Oct. 7, 1940	258	18.0	8.3	87.2	.7	2	7.6	10	60	54
Do	do	Oct. 11, 1940	187	12.5	8.7	81.5	1.4	(1)	7.4	13	56	
Do	do	Oct. 17, 1940	200	8.5	8.6	73.5	.8	2	7.4	10	56	
Calfkiller River, above Sparta, Tenn.	CCfCa 396	Feb. 4, 1941	158	7.0	11.6	95.2	3.9	(1)	7.5	5	89	71
Do	do	Feb. 6, 1941	134	8.0	11.4	95.7	.7	(1)	7.5	5	88	
Do	do	Feb. 10, 1941	128	6.0	11.9	95.4	2.5	2	7.5	5	95	
Calfkiller River, below Sparta, Tenn.	CCfCa 394	Feb. 4, 1941	160	7.0	11.2	91.7	1.6	930	7.5	5	83	66
Do	do	Feb. 6, 1941	143	8.0	11.2	94.7	1.7	930	7.5	10	88	
Do	do	Feb. 10, 1941	100	6.0	11.6	92.9	5.8	930	7.5	5	79	
Barren Fork River, water works above McMinnville.	CCfBaf 393	Feb. 3, 1941	84	7.0	10.8	88.4	3.5	1	7.4	10	78	60
Do	do	Feb. 5, 1941	169	7.0	11.5	94.8	2.0	(1)	7.5	10	89	
Do	do	Feb. 7, 1941	81	5.5	11.3	89.6	1.7	1	7.4	5	92	
Barren Fork River, dam below McMinnville, Tenn.	CCfBaf 392	Feb. 3, 1941	83	7.0	11.6	95.6	3.8	43	7.5	10	76	55
Do	do	Feb. 5, 1941	169	7.5	11.9	99.0	2.0	43	7.6	10	114	
Do	do	Feb. 7, 1941	81	5.5	11.8	93.2	2.3	14	7.4	5	94	
Falling Water River, above Cookeville, Tenn.	CCfFw 358	Feb. 4, 1941	25	5.0	11.5	89.8	1.6	1	7.5	5	109	81
Do	do	Feb. 6, 1941	26	7.0	11.4	93.7	1.0	1	7.5	10	120	
Do	do	Feb. 10, 1941	21	3.0	12.0	89.2	2.3	(1)	7.5	5	103	
Pigeon Roost Creek, below Cookeville, Tenn.	CCfFwP 362	Feb. 6, 1941	7	10.0	7.8	68.7	6.1	230	7.5	10	122	
Do	do	Feb. 10, 1941	7	7.5	7.4	61.7	12.5	150	7.4	5	112	
Falling Water River, below Cookeville, Tenn.	CCfFw 356	Feb. 4, 1941	38	5.0	11.3	88.4	1.5	4	7.5	5	110	81
Do	do	Feb. 6, 1941	37	7.0	10.9	89.6	.6	4	7.5	10	118	
Do	do	Feb. 10, 1941	35	3.5	11.4	85.7	3.3	9	7.5	5	105	
Barton Creek, above Lebanon, Tenn.	CB 261	Jan. 22, 1941	4	11.0	8.2	73.8	6.4	930	7.4	10	188	170
Do	do	Jan. 24, 1941	82	13.0	8.2	77.0	2.1	150	7.3	200	185	
Do	do	Jan. 28, 1941	8	8.0	8.9	75.3	1.2	36	7.4	5	200	
Do	do	Jan. 30, 1941	4	9.0	9.5	81.6	1.5	23	7.5	5	194	

Barton Creek, below Lebanon, Tenn.	CB 259	Jan. 22, 1941	4	9.0	11.6	100.4	6.9	(1)	7.6	5	204	151
Do	do	Jan. 24, 1941	258	10.0	7.0	62.0	16.7	430	7.4	550	119	
Do	do	Jan. 28, 1941	18	6.5	7.3	59.3	6.2	930	7.5	5	203	
Do	do	Jan. 30, 1941	10	7.0	8.0	65.7	3.7	36	7.5	5	194	
North Fork Station, Camp Creek below Gallatin, Tenn.	CSeNf 240	Jan. 22, 1941	1	11.0	4.7	42.2	37.4	1,500	7.4	15	228	191
Do	do	Jan. 24, 1941	55	8.0	10.4	88.0	12.8	930	7.3	440	74	
North Fork Station, Camp Creek, below Gallatin, Tenn.	CSeNf 240	Jan. 28, 1941	10	7.0	11.2	91.7	4.1	36	7.5	10	159	
Do	do	Jan. 30, 1941	10	6.0	11.3	90.4	5.0	23	7.6	15	165	
West Fork, Stone River, above Woodbury, Tenn.	CStWf 271	Feb. 3, 1941	19	7.0	11.9	97.6	8.7	4	7.7	5	136	134
Do	do	Feb. 5, 1941	16	8.0	12.5	105.5	1.7	2	7.9	5	139	
Do	do	Feb. 7, 1941	14	6.0	12.1	97.3	2.2	9	7.8	63	144	
West Fork, Stone River, below Woodbury, Tenn.	CStWf 269	Feb. 3, 1941	19	8.0	10.9	91.8	5.7	93	7.6	10	139	140
Do	do	Feb. 5, 1941	16	8.0	11.5	96.7	8.4	2,400	7.4	10	160	
Do	do	Feb. 7, 1941	14	7.0	10.6	87.4	7.9	9	7.6	10	158	
West Fork, Stone River, above Murfreesboro, Tenn.	CStWf 252	Jan. 22, 1941	22	9.5	12.2	106.5	3.8	2	7.9	5	166	125
Do	do	Jan. 24, 1941	220	10.0	10.3	90.9	4.7	24	7.7	40	152	
Do	do	Jan. 28, 1941	160	5.0	11.6	90.9	3.5	24	7.7	45	180	
Do	do	Jan. 30, 1941	90	6.0	12.5	100.3	3.9	23	8.1	20	189	
West Fork, Stone River, below Murfreesboro, Tenn.	CStWf 248	Jan. 22, 1941	27	7.5	12.6	105.2	4.9	2	7.8	5	164	129
Do	do	Jan. 24, 1941	250	10.0	11.9	105.4	3.2	4	8.0	5	168	
Do	do	Jan. 28, 1941	170	6.0	11.7	93.9	3.2	110	7.7	40	177	
Do	do	Jan. 30, 1941	54	6.0	12.6	101.0	2.3	9	8.1	15	183	
Mill Creek, ½ mile below Nashville, State Hospital.	CM 197	Jan. 23, 1941	6	9.0	11.7	100.6	5.0	460	7.9	5	155	149
Do	do	Jan. 27, 1941	30	7.0	11.5	94.8	2.0	930	8.0	15	200	
Do	do	Jan. 29, 1941	30	4.0	12.9	98.2	1.5	1,500	8.0	5	214	
Do	do	Jan. 31, 1941	22	6.0	13.4	107.4	2.7	240	8.1	5	216	
Harpeth River, above Franklin, Tenn.	CHr 223	Jan. 23, 1941	19	9.0	11.7	101.1	4.7	1	8.1	5	161	131
Do	do	Jan. 27, 1941	158	8.0	10.8	91.2	4.3	24	7.9	45	160	
Do	do	Jan. 29, 1941	101	4.0	12.2	93.1	.9	2	7.9	20	179	
Do	do	Jan. 31, 1941	57	7.0	12.3	101.2	3.1	1	8.0	10	168	
Harpeth River, below Franklin, Tenn.	CHr 221	Jan. 23, 1941	27	9.0	11.1	95.9	7.0	1,100	7.9	5	171	131
Do	do	Jan. 27, 1941	206	8.0	10.7	90.5	3.5	430	7.8	41	158	
Do	do	Jan. 29, 1941	199	4.0	12.2	93.2	2.8	930	7.8	10	180	
Do	do	Jan. 31, 1941	81	6.0	12.2	97.4	4.3	240	7.8	10	177	
Harpeth Creek, 1 mile below Dickson, Tenn.	CHrT 177	Jan. 23, 1941	1	9.0	7.1	61.3	32.6	46,000	7.0	45	139	105
Do	do	Jan. 27, 1941	4	8.0	9.5	80.4	7.4	24,000	7.2	10	80	
Do	do	Jan. 29, 1941	2	7.0	9.3	76.7	12.6	24,000	7.1	10	90	
Do	do	Jan. 31, 1941	2	8.0	9.0	75.5	7.4	930	7.2	10	100	

[1] Less than 1.

TABLE C-7.—*Cumberland River Basin: Ohio River pollution survey laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardnes , parts per million
					Parts per million	Percent of saturation						
Cumberland River, above Clarksville, Tenn.	C 127	Nov. 8, 1940	1,180	11.5	7.9	72.4	2.3	(1)	6.9	10	70	78
Do	do	Nov. 13, 1940	5,290	6.0	8.4	67.0	2.2	110	7.1	140	74	
Do	do	Nov. 15, 1940	2,590	0	8.1	55.4	2.9	39	7.2	40	80	
Cumberland River, below Clarksville, Tenn.	C 126	Nov. 8, 1940	1,180	10.5	8.1	72.2	1.9	9	6.9	10	70	78
Do	do	Nov. 13, 1940	5,290	9.5	8.3	72.3	2.4	150	7.1	160	70	
Do	do	Nov. 15, 1940	2,590	0	9.3	63.6	1.9	43	7.3	35	78	
Red River, near Adams, south of Guthrie.	CR 148	Nov. 8, 1940	69	3.5	10.1	76.0	1.2	4	7.8	10	64	130
Do	do	Nov. 13, 1940	429	2.5	10.1	74.2	1.3	110	7.3	130	118	
Do	do	Nov. 15, 1940	167	0	12.0	82.1	1.9	93	7.5	95	122	
Sulphur Creek, above Springfield, Tenn.	CRSu 163	Nov. 8, 1940	8	4.0	9.2	70.1	1.9	4	7.5	10	128	134
Do	do	Nov. 13, 1940	22	5.0	10.4	81.3	1.9	93	7.3	90	106	
Do	do	Nov. 15, 1940	12	0	12.5	85.7	1.7	15	7.5	20	134	
Sulphur Creek, below Springfield, Tenn.	CRSu 161	Nov. 8, 1940	8	3.5	7.2	54.1	8.2	4,400	7.5	10	146	136
Do	do	Nov. 13, 1940	22	1.5	9.1	65.1	3.6	910	7.4	100	98	
Do	do	Nov. 15, 1940	12	0	11.2	76.7	5.2	1,500	7.3	20	118	
Spring Creek, below Guthrie, Ky	CRWfSp 139	Nov. 8, 1940	2	4.5	7.1	54.9	4.2	23	6.9	10	82	222
Do	do	Nov. 13, 1940	1	6.0	9.9	79.0	6.9	23	6.5	5	26	
Do	do	Nov. 15, 1940	2	1.0	11.6	81.5	9.3	9	7.1	15	62	
Red River, above mouth, Clarksville, Tenn.	CR 126	Nov. 8, 1940	148	10.5	8.8	78.8	1.2	1	7.7	10	158	146
Do	do	Nov. 13, 1940	554	5.0	9.4	73.8	1.7	110	7.3	210	118	
Do	do	Nov. 15, 1940	256	1.0	10.8	75.5	1.1	150	7.5	110	76	
Cumberland River, branch, Canton, Ky.	C 63	Nov. 12, 1940	7,360	4.5	9.7	74.6	.8	43	7.5	40	84	
Do	do	Nov. 14, 1940	2,370	2.5	10.4	76.2	1.4	9	7.3	10	88	
Do	do	Nov. 18, 1940	2,260	1.5	10.5	74.8	1.3	4	7.3	20	76	82
North Fork, Little River, above Hopkinsville, Ky.	CLrNf 107	Nov. 12, 1940	2	5.0	4.0	31.3	3.9	240	6.9	430	74	
Do	do	Nov. 14, 1940	1	3.5	2.9	21.7	10.4	460	6.9	410	44	
Do	do	Nov. 18, 1940	1	6.0	4.1	32.8	3.4	9	6.6	360	42	50
North Fork, Little River, below Hopkinsville, Ky.	CLrNf 104	Nov. 12, 1940	4	4.5	6.7	51.7	3.9	230	7.3	35	102	
Do	do	Nov. 14, 1940	2	2.5	8.2	60.0	4.0	230	7.3	10	130	
Do	do	Nov. 18, 1940	1	2.5	7.8	57.1	3.6	430	7.4	23	134	138

South Fork, Little River, Hopkinsville, Ky.	CLrSf 104	Nov. 12, 1940	1	----------	1.6	----------	12.5	930	7.5	25	276	----------
Do	do	Nov. 14, 1940	1	2.0	2.2	16.0	19.4	930	7.3	30	292	----------
Do	do	Nov. 18, 1940	1	5.0	.9	7.1	9.6	930	7.5	25	296	172
Little River, 4½ miles below Hopkinsville, Ky.	CLr 98	Nov. 12, 1940	14	7.5	6.1	50.9	6.2	1,100	7.3	250	82	----------
Do	do	Nov. 14, 1940	4	2.5	7.6	55.8	2.6	23	7.2	50	124	----------
Do	do	Nov. 18, 1940	3	3.0	9.8	72.8	1.8	9	7.5	15	148	132
Little River, above Cadiz, Ky	CLr 72	Nov. 12, 1940	186	4.0	7.6	57.7	1.6	240	7.6	170	142	----------
Do	do	Nov. 14, 1940	34	3.5	8.3	62.4	3.0	460	7.3	150	120	----------
Do	do	Nov. 18, 1940	28	3.0	10.0	74.2	2.6	20	7.4	40	140	118
Little River, below Cadiz, Ky	CLr 71	Nov. 12, 1940	186	4.5	9.3	71.9	1.7	240	7.7	240	134	----------
Do	do	Nov. 14, 1940	34	3.5	9.4	71.1	2.7	240	7.4	130	132	----------
Do	do	Nov. 18, 1940	30	5.0	11.3	88.4	2.2	23	7.4	70	138	114
Spring, Eddy Creek, above Princeton, Ky.	CEdSp 65	Oct. 29, 1940	1	19.0	8.4	89.8	.6	2	6.8	5	200	170
Do	do	Nov. 1, 1940	1	16.0	8.5	85.3	1.0	2	7.8	5	226	----------
Do	do	Nov. 6, 1940	1	9.5	8.6	75.1	.6	2	6.8	5	196	----------
Eddy Creek, below Princeton, Ky	CEd 63	Oct. 29, 1940	1	18.5	0	0	187.0	240,000	6.9	95	250	174
Do	do	Nov. 1, 1940	2	16.0	1.6	15.7	35.3	23,000	7.9	140	88	----------
Do	do	Nov. 6, 1940	1	8.5	6.0	51.2	17.1	360	7.1	18	164	----------
Cumberland River, Eddyville Ferry	C 44	Oct. 29, 1940	830	19.5	9.4	101.5	1.7	8	7.7	15	78	72
Do	do	Nov. 1, 1940	1,150	16.5	8.4	85.2	1.1	2	7.5	10	82	----------
Do	do	Nov. 6, 1940	2,370	10.0	9.4	83.0	1.5	(1)	7.6	15	74	----------
Cumberland River, Kuttawa Ferry	C 41	Oct. 29, 1940	830	20.0	8.9	97.1	1.9	46	7.7	15	80	80
Do	do	Nov. 1, 1940	1,150	18.0	8.6	90.3	1.6	21	7.5	13	82	----------
Do	do	Nov. 6, 1940	2,370	9.5	9.8	85.5	1.9	4	7.6	20	72	----------
Cumberland River, at mouth	C 2.8	Sept. 20, 1940	1,990	24.5	7.6	90.2	1.2	1	7.7	18	77	82
Do	do	Sept. 25, 1940	910	21.0	7.1	78.9	1.9	1	7.7	28	76	----------
Do	do	Sept. 26, 1940	1,020	20.5	7.5	82.4	1.5	5	7.7	20	77	----------
Do	do	Oct. 1, 1940	2,200	21.0	8.8	97.9	1.4	(1)	7.9	30	83	----------
Do	do	Nov. 14, 1940	3,760	10.0	9.9	87.1	1.4	9	7.3	45	87	----------
Do	do	Nov. 15, 1940	2,250	8.0	9.4	79.6	1.0	2	7.5	41	88	96
Do	do	Nov. 16, 1940	1,880	7.5	9.8	81.5	1.2	8	7.3	25	90	----------
Do	do	Nov. 18, 1940	2,710	10.0	10.5	92.7	1.3	2	7.5	18	92	----------
Do	do	Mar. 1, 1941	4,750	5.0	12.9	100.6	1.8	2	7.6	25	90	----------
Do	do	Mar. 4, 1941	8,800	6.0	12.9	103.6	1.5	1	7.6	20	83	112
Do	do	Mar. 5, 1941	8,040	6.0	13.0	104.6	1.1	(1)	7.7	20	86	----------

[1] Less than 1.

GREEN RIVER BASIN

CONTENTS

	Page
Contents	797
Syllabus and conclusions	799
Description	800
Presentation of field data	801
Presentation of laboratory data	803
Hydrometric data	804
Discussion	805

LIST OF TABLES

Gr–1. Cost estimates of remedial measures	800
Gr–2. Surface water supplies	801
Gr–3. Sources of pollution	802
Gr–4. Industrial wastes	802
Gr–5. Selected laboratory data	803
Gr–6. Monthly mean summer flows	804
Gr–7. Summary of laboratory data	806

LIST OF FIGURES

Gr–2. Chart—Sources of pollution and selected laboratory data	802

(NOTE—For maps of this basin see Cumberland River Basin.)

GREEN RIVER BASIN [1]

Syllabus and Conclusions

SYLLABUS

The Green River drains 9,220 square miles of rolling and hilly land largely in west central Kentucky but extending to northern Tennessee. Although predominantly an agricultural area, coal is mined extensively in the western part of the basin. About 10 percent of the total population of 440,000 is urban. Sewage from nearly 75 percent of the sewered population is treated and there are no industrial wastes of importance. Acid mine drainage damages a number of the small tributaries but has no noticeable effect on the larger streams. Pollution problems are local in character and abatement can be effected by known methods of treatment.

CONCLUSIONS

(1) Nine of the 39 public water supplies are taken from streams below sources of pollution, but none of the supplies is seriously polluted.

(2) Of the 45,000 sewered population, the sewage from 34,300 is treated. Industrial wastes from 13 small plants have a total population equivalent of 3,800.

(3) Laboratory data show the larger streams of the basin to be in good sanitary condition, and many of the small streams to be grossly polluted by untreated or inadequately treated sewage. Acid mine drainage was found in only one stream during the laboratory survey.

(4) The minimum monthly mean summer flows of record on the Green River at lock No. 6 and the Barren River at lock No. 1 are 230 cubic feet per second and 162 cubic feet per second, respectively.

(5) Proposed flood-control reservoirs studied by the United States Engineer Department are so located as to be of little benefit to pollution abatement.

(6) Sewage, although receiving primary treatment, affects the smaller tributaries having extremely low flows. Secondary treatment seems justified at these places. Primary treatment should be adequate for towns on the main stream and on its larger tributaries.

(7) Most of the industrial wastes can be effectively treated at the municipal treatment plants.

(8) Estimated costs of the suggested pollution-abatement program for the basin and of the work already done from table Gr–1 are summarized below:

Treatment	Capital cost	Annual charges
Existing	$450,000	$55,000
Suggested additional	780,000	80,000

[1] For maps of this basin, see Cumberland River Basin.

Estimated additional costs, over existing charges, of programs involving uniform treatment throughout the basin are

Treatment	Capital cost	Annual charges
Primary, all places	$550,000	$50,000
Secondary, all places	960,000	100,000

TABLE GR–1.—*Green River Basin: Estimated cost of existing and suggested minimum corrective measures for sewage and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	8	3	34,300	$450,000	$30,000	$25,000	$55,000
Suggested minimum correction:							
Sewage-treatment plants	9	7	10,900	600,000	40,000	30,000	70,000
Required interceptors				180,000	10,000		10,000
Independent industrial waste correction							
Total				780,000	50,000	30,000	80,000
Comparative cost:							
Primary treatment, all waste				550,000	34,000	16,000	50,000
Secondary treatment, all waste				960,000	64,000	36,000	100,000
As suggested				780,000	50,000	30,000	80,000

DESCRIPTION

The Green River drains an area of 9,220 square miles in west central Kentucky. About 380 square miles of the basin are in Tennessee. Larger tributaries are—

Tributaries	Distance above mouth of Green River	Drainage area, square miles	Tributaries	Distance above mouth of Green River	Drainage area, square miles
Pond River	55	756	Barren River	150	2,132
Rough River	71	1,025	Nolin River	184	750
Mud River	109	430			

Population of urban communities and of the basin as a whole, for the past 30 years, are tabulated below.

	Populations			
	1910	1920	1930	1940
Urban communities:				
Bowling Green	9,173	9,638	12,438	14,585
Madisonville	4,966	5,030	6,908	8,209
Glasgow	2,316	2,559	5,042	5,815
Central City	2,545	3,108	4,321	4,199
Russellville	3,111	3,124	3,297	3,983
Franklin	3,063	3,154	3,056	3,940
Elizabethtown	1,970	2,530	2,590	3,667
Entire basin:				
Rural	401,233	398,307	377,209	399,994
Urban	22,858	29,143	37,652	44,398
Total	424,091	427,450	414,861	444,392

None of the urban communities and only about 8 percent of the rural population is in the Tennessee portion of the basin.

Agriculture is the principal occupation, although a large part of the area is too hilly for cultivation. Coal is mined extensively in the western part of the basin. Cavernous limestone underlies much of the region and considerable areas have no well-defined watercourses. Drainage collects in shallow depressions and "sinks" and is either evaporated or disappears into the limestone caves. Mammoth Cave is in this basin.

Water uses.—Six locks and dams on the Green River and one each on the Barren and Rough Rivers, provide a 4- to 5½-foot navigation channel as far as Mammoth Cave on the Green River, Bowling Green on the Barren, and Hartford on the Rough. Less than 200,000 tons of freight are carried annually, the principal commodity being asphalt. The Green and most of its tributaries are considered good fishing streams and are extensively used for recreation by local residents.

Presentation of Field Data

Figure C–1 shows the location and magnitude of each source of pollution of consequence in the basin. Figure Gr–2 shows similar data and, in addition, the location of water intakes from streams below sources of pollution and laboratory data on coliform organisms, dissolved oxygen and biochemical oxygen demand.

Public water supplies.—Of the 39 public water supplies in the basin, 21 are from surface sources and 18 are from wells and springs. About 20,000 people use underground supplies and 50,000 use surface supplies. Table Gr–2 shows data on the surface water supplies of the basin.

Table Gr–2.—*Green River Basin: Surface Water Supplies*

Supply	Source	Mile [1]	Treatment [2]	Population served	Consumption, million gallons per day
	Supplies below community sewer outfalls				
Calhoun	Green river	63.4	D	600	0.04
Livermore	do	71.3	FD	1,200	.06
Central City	do	86	FD	3,800	.36
Rockport	do	95.0	FD	400	.01
Morgantown	do	143.3	CD	800	.06
Brownsville	do	180.5	None	300	.02
Munfordville	do	213	SD	500	.02
Greensburg	do	260	FD	800	.04
Bowling Green	Barren River	187	FD	15,000	1.20
	Other surface supplies				
Hartford	Rough River	101	FD	1,200	.07
Franklin	Drakes Creek (impounded)	230	FD	3,300	.20
Glasgow	Beaver Creek	250	FD	4,000	.21
Tompkinsville	Mill Creek (impounded)	270	FD	600	.04
Hodgenville	North fork Nolin River (impounded)	269	FD	1,200	.06
Campbellsville	Pittman Creek (impounded)	270	FD	2,600	.09
Columbia	Russell Creek	295	FD	1,000	.04
Liberty	Green River	326	FD	600	.02
Madisonville	Impounded		FD	8,500	.50
Mortons Gap	do		FD	500	.01
Graham	do		D	1,000	.02
Greenville	do		FD	2,400	.10
Total:					
Below sewer outfalls				23,400	1.81
Other				26,900	1.36
Total surface water supplies				50,300	3.17

[1] Miles above mouth of Green River.
[2] F=Coagulated, settled, filtered; C=Coagulated, settled; S=Settled; D=Chlorinated.

Sewerage.—Table Gr–3 shows the sewered population at each of the more important sources of pollution in the basin, all in Kentucky. Sewage from 34,300 persons, of the 45,000 to whom sewerage is available, is treated; that from 29,300 by primary and that from 5,000 in secondary treatment works.

TABLE GR–3.—*Green River Basin: Sources of pollution including industrial wastes, expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Stream	Miles above mouth of Green River	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand)	
					Untreated	Discharged
Central City	Cypress Creek	90	3,000	None	3,000	3,000
Madisonville	Flat Creek	90	7,600	Primary	7,700	5,000
Beaver Dam	Muddy Creek	104	600	do	600	400
Hartford	Rough River	100	1,100	None	1,300	1,300
Greenville	Pond Creek	117	900	do	900	900
Russellville	Town Branch	157	3,000	Primary	3,200	2,100
Bowling Green	Barren River	176	13,000	do	15,200	10,600
Franklin	Drakes Creek	230	2,600	do.[1]	2,600	2,600
Scottsville	South Bays Fork	226	600	do	600	400
Glasgow	South fork Beaver Creek.	250	3,900	do	4,400	2,900
Elizabethtown	Valley Creek	261	2,600	Secondary	2,800	400
Hodgenville	North fork Nolin River	269	900	do	900	100
Cave City	Sinkholes	200	500	None	500	500
Campbellsville	Buckhorn Creek	270	1,500	Secondary	1,700	300
Columbia	Russell Creek	294	600	None	600	600
11 smaller sources			2,600	[2]	2,800	2,700
Total			45,000		48,800	33,800

[1] 1 small Imhoff tank receives about 8 percent of sewage.
[2] 1 primary plant; no treatment at 10 other places.

Industrial wastes.—Thirteen small plants in the basin discharge wastes of significance. Wastes from seven of these are treated at municipal sewage treatment plants. Table Gr–4 shows data on the remaining six plants, four of which discharge wastes to caverns.

TABLE GR–4.—*Green River Basin: Summary of industrial wastes not discharged to municipal treatment plants with total of entire industrial waste load in the Basin.*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlet		
Milk	2	0	2	2	400
Meat	3	0	3	3	1,800
Miscellaneous	1	0	1		200
Waste unconnected municipal treatment	6	0	6	5	2,400
Waste connected to municipal treatment					1,400
Total industrial waste in basin					3,800

Acid mine drainage.—Prior to the mine sealing program some 76,500 tons of acid entered the streams each year from the coal mines in the western part of the basin. This has been reduced by about 20 percent by sealing some of the largest acid-producing mines. A considerable

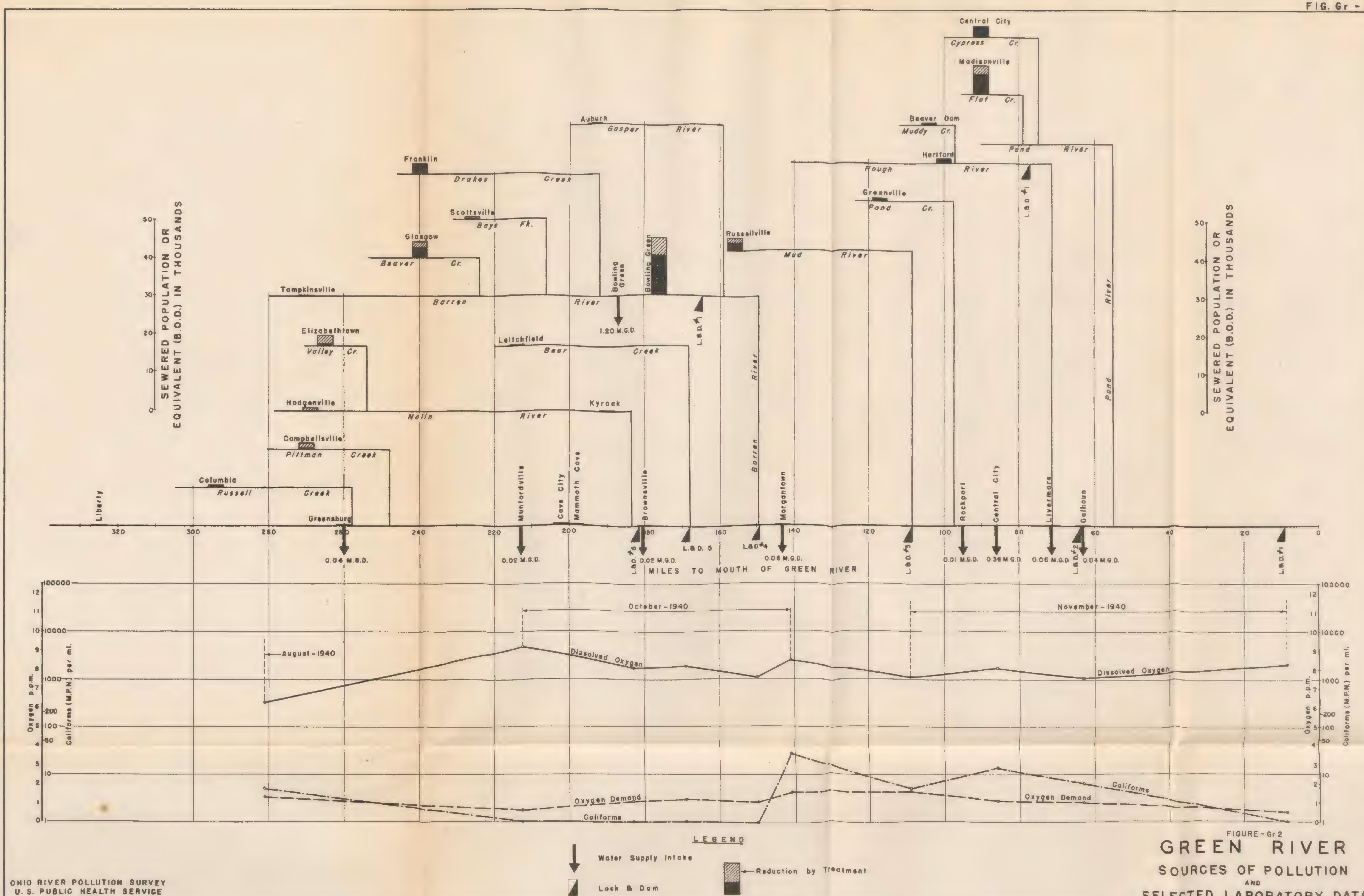


FIGURE - Gr 2
GREEN RIVER
SOURCES OF POLLUTION AND SELECTED LABORATORY DATA

amount of work remains to be done. The relatively high natural alkalinity of the normal stream waters tends to localize the effects of mine acid discharges.

Presentation of Laboratory Data

The laboratory survey of this basin, especially the lower section, was made during a very dry season. Below sewer outlets on small tributaries, sewage comprised from 65 to 75 percent of the total stream flow. Because of ponding, seepage and evaporation streams were usually dry a few miles below town. Observations were made during August, October, and November 1940 and February 1941 by trailer units.

General summaries of Green River data are shown in table Gr–7 (p. 806) and selected data are tabulated in table Gr–5. Figures C–3, C–4, and C–5 (p. 780) show the results of the coliform, dissolved oxygen and biochemical oxygen demand determinations at the various sampling points in diagrammatic form. The averages are from three samples collected during a period of less than a month, except at the mouth, where they indicate the most unfavorable monthly average obtained during three months.

TABLE GR–5.—*Green River Basin: Selected laboratory data*

River	Green	Green	Green	Buckhorn Creek	Nolin	Valley Creek	South Beaver Creek
Location	Below Munfordville	At Lock No. 3	At Spottsville	Below Campbellsville	Below Hodgenville	Below Elizabethtown	Below Glasgow
River miles above—							
Confluence with Green				20	83.5	80	90.5
Mouth of Green	212.5	103	8.6	268	267	263.5	240
Period, 1940	October	October–November	October	August	August	August	October
Number of samples	3	3	2	3	3	3	3
Flow in cubic feet per second:							
Sampling days	103	737		(1)	1	3	1
Minimum month	108		558				
Water temperature, ° C	13.3	9.5	17.5	22.2	21.8	21.8	13.5
Coliforms per milliliter	1	5	1	1,680	210	1,190	467,000
Dissolved oxygen, parts per million	9.2	7.6	8.3	5.4	5.0	2.1	3.1
Biochemical oxygen demand, 5-day, parts per million	0.6	1.6	0.5	8.7	3.0	8.0	313

River	Bays Fork	Town Branch	Muddy Creek	Barren	Barren	Flat Creek	Cypress Creek
Location	Below Scottsville	Below Franklin	Below Beaver Dam	Above Bowling Green	Below Bowling Green	Below Madisonville	Below Central City
River miles above—							
Confluence with Green	74.5	80.5	33	38	26.5	25	27
Mouth of Green	224	228	104	187.5	176	80	82
Period, 1940	October	October	October	October	October	October–November	October–November
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	(1)	(1)	(1)	95	97	1	(1)
Water temperature ° C	13.3	9.8	10.2	15.7	18.7	19.2	10.8
Coliforms per milliliter	9,300	32,000	300,000	15	1,340	412,000	42,000
Dissolved oxygen, parts per million	7.3	0	0	8.6	8.1	1.4	0.5
Biochemical oxygen demand, 5-day, parts per million	8.3	141	192	1.4	2.3	266	21.2

[1] Less than 1.

Laboratory data show no particular pollution problem on the Green River itself, there being no communities of consequence discharging sewage into the main stream. The major pollution problems result from local nuisances below towns on the smaller streams with the worst conditions prevailing below Beaver Dam, Central City, Elizabethtown, Franklin, Glasgow, Madisonville, Russellville, and Scottsville.

Pond River drains a large coal-mining area but at the time of the survey mines were mostly shut down and those working were pumping mine water intermittently. With low flows and ponding, wastes were not reaching the streams except at Nortonville where acid stream conditions were observed on Drakes Creek.

Biological summary.—The plankton population of the Green is extremely low, usually less than 2,000 parts per million. These low values are due to the fact that the stream flows through a region of poor soil, low in organic matter, and there are no important sources of pollution along the stream.

HYDROMETRIC DATA

Eleven stream gaging stations have been maintained in the Green Basin at various times, six of which are currently in operation. Table Gr–6 shows mean monthly flows at representative stations during some low-flow years.

TABLE GR–6.—*Green River Basin: Monthly mean summer flows for years in which low summer flows have occurred*

River	Green	Green	Rough	Barren
Location	Munfordville, Ky.	Livermore, Ky.	Dundee, Ky.	Greencastle, Ky.
River miles above—				
Confluence with Green			57	15
Mouth of Green	213	70	128	164
Drainage area (square miles)	1,790	7,580	764	1,950
Period of record	1915–22 1927–40	1930–40	1930–40	1925–31
Year	1930	1930	1931	1930
June—cubic feet per second	226	1,160	27	563
July—do	182	706	67	368
August—do	108	482	280	178
September—do	200	524	155	162
Year	1939	1939	1935	1925
June—cubic feet per second	1,692	7,778	1,790	534
July—do	1,000	3,183	670	401
August—do	810	2,438	150	166
September—do	143	530	28	162
Year	1919	1940	1936	1927
June—cubic feet per second	1,100	2,480	28	3,470
July—do	437	1,597	64	902
August—do	398	1,210	31	675
September—do	147	740	205	251

Low-flow regulation.—Sites for possible flood-control reservoirs in the basin have been studied by the United States Engineer Department in connection with the authorized program for flood control on the Ohio River and its tributaries. These reservoirs would be located on the Green, Barren, Rough, and Nolin Rivers. The largest, on the Green River below the mouth of Mud River, would have a capacity in excess of 3,000,000 acre-feet. Consideration has been given to the operation of the proposed reservoirs to augment stream flows during the summer months.

Discussion

Of the 15 sources of pollution listed in table Gr–3, none is on the Green River itself and 2, Bowling Green and Hartford, are on tributary streams with an appreciable reliable flow during the summer. As noted in the discussion of the laboratory studies, most of the receiving streams contained a high percentage of sewage. Secondary treatment appears justified at places such as Madisonville, Russellville, Glasgow, Central City, and Franklin. At Bowling Green and Hartford and at the communities along the Green River primary treatment combined with dilution should be sufficient to maintain satisfactory stream conditions. At Cave City where there are no surface streams and all wastes enter the caverns beneath the town, primary treatment and continuous chlorination should be adequate to prevent pollution of the underground water. Industrial wastes present no particular problems. All of the plants are small, and the wastes can be treated at municipal treatment plants with the sewage.

Further reductions in the acidity of the streams in the western part of the basin can be effected by a renewal of the mine-sealing program. A large part of the acid load comes from active mines.

Low-flow augmentation by the proposed flood-control reservoirs would be beneficial but would have no tangible monetary value to pollution abatement, since primary treatment will be sufficient for wastes discharged to the streams which might be affected by the increased flows.

The estimated cost of the suggested pollution-abatement program and of programs for primary and for secondary treatment of all wastes is shown in table Gr–1.

TABLE GR-7.—*Green River Basin: Ohio River Pollution Survey Laboratory data—Summary of individual results*

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Green River, bridge on Route 55, Campbellsville, Ky.	Gr 281	Aug. 14, 1940	41	25.5	6.2	74.3	1.5	8	7.4	45	64	64
Do	do	Aug. 19, 1940	18	23.5	5.6	65.5	.9	2	7.4	40	64	
Do	do	Aug. 21, 1940	14	21.0	7.1	79.0	1.5	4	7.6	40	62	
Russell Creek, water plant intake, Columbia, Ky.	GrR 296	Aug. 14, 1940	6	26.0	6.5	78.6	2.5	4	7.5	10	94	88
Do	do	Aug. 19, 1940	4	23.5	5.6	65.3	2.3	4	7.5	30	90	
Do	do	Aug. 21, 1940	4	21.0	7.3	81.3	2.2	4	7.6	25	88	
Russell Creek, below septic tank, Columbia, Ky.	GrR 290	Aug. 14, 1940	8	27.0	7.0	86.6	3.3	390	7.5	10	96	86
Do	do	Aug. 19, 1940	6	24.0	6.1	71.0	2.0	930	7.4	35	98	
Do	do	Aug. 21, 1940	6	21.0	7.6	84.6	2.1	1,500	7.6	30	94	
East Fork Pittman Creek, above Campbellsville, Ky.	GrP 270	Aug. 14, 1940	(1)	25.5	7.2	86.6	3.0	46	7.7	30	90	78
Do	do	Aug. 19, 1940	(1)	23.5	6.7	77.7	1.9	43	7.7	10	88	
Do	do	Aug. 21, 1940	(1)	20.0	7.2	79.1	2.1	7	7.7	5	88	
Buckhorn Creek, below Campbellsville, Ky.	GrPB 268	Aug. 14, 1940	(1)	24.5	3.9	46.4	11.7	4,600	7.5	5	170	200
Do	do	Aug. 19, 1940	(1)	22.5	5.4	61.9	5.2	360	7.7	5	162	
Do	do	Aug. 21, 1940	(1)	19.5	6.8	72.9	9.1	93	7.7	10	164	
Green River, below Munfordville, Ky.	Gr 212.5	Oct. 8, 1940	110	11.5	8.8	80.3	.6	2	7.7	8	120	106
Do	do	Oct. 14, 1940	100	15.5	9.3	92.5	.5	(1)	7.7	10	132	
Do	do	Oct. 18, 1940	100	13.0	9.5	89.6	.8	1	7.7	8	128	
North Fork Nolin River, above Hodgenville, Ky.	GrNNf 272	Aug. 12, 1940	4	27.5	3.8	47.1	2.0	23	7.4	225	92	110
Do	do	Aug. 15, 1940	(1)	22.5	3.6	41.5	2.1	24	7.4	75	116	
Do	do	Aug. 22, 1940	(1)	17.0	4.2	43.3	.9	8	7.6	35	138	
North Fork Nolin River, below Hodgenville, Ky.	GrNNf 267	Aug. 12, 1940	4	26.0	4.7	57.2	4.4	240	7.2	320	80	128
Do	do	Aug. 15, 1940	(1)	22.5	4.9	56.5	2.5	150	7.4	75	108	
Do	do	Aug. 22, 1940	(1)	17.0	5.5	56.6	2.0	240	7.5	40	140	
Valley Creek, above Elizabethtown, Ky.	GrNV 267	Aug. 12, 1940	1	27.5	3.5	43.8	12.1	930	7.2	15	150	88
Do	do	Aug. 15, 1940	(1)	23.0	0	0	11.5	430	7.1	40	158	
Do	do	Aug. 22, 1940	(1)	17.5	2.9	30.1	9.1	4,600	7.5	15	164	
Valley Creek, below Elizabethtown, Ky.	GrNV 263.5	Aug. 12, 1940	4	26.0	1.5	18.2	9.5	240	7.4	5	192	164
Do	do	Aug. 15, 1940	2	22.0	3.4	38.7	11.2	2,400	7.3	25	176	
Do	do	Aug. 22, 1940	2	17.5	1.3	13.7	3.3	930	7.5	100	178	

Nolin River, below Kyrock, Ky	GrN 196.5	Oct. 8, 1940	75	12.0	8.3	77.0	1.1	4	7.9	13	130	128
Do	do	Oct. 14, 1940	72	17.5	8.8	91.6	.5	1	7.8	8	134	
Do	do	Oct. 18, 1940	66	13.0	9.1	85.9	.8	2	7.7	10	134	
Green River, above lock and dam No. 6.	Gr 150	Oct. 8, 1940	210	15.0	7.6	74.9	1.1	2	7.7	8	120	118
Do	do	Oct. 14, 1940	195	16.0	8.2	82.8	1.1	(1)	7.7	l	130	
Do	do	Oct. 18, 1940	180	11.0	8.3	75.2	1.2	(1)	7.7	l	130	
Green River, above lock and dam No. 5.	Gr 169	Oct. 8, 1940	210	18.5	7.9	83.3	1.1	(1)	7.7	8	117	108
Do	do	Oct. 14, 1940	195	21.5	8.1	91.1	1.0	1	7.7	5	122	
Do	do	Oct. 18, 1940	180	17.5	8.8	90.8	1.4	(1)	7.8	5	116	
Bear Creek, at mouth	GrBr 169	Oct. 8, 1940	(1)	18.5	7.7	82.0	1.1	2	7.7	5	114	114
Do	do	Oct. 14, 1940	(1)	22.0	7.9	89.8	.9	1	7.7	10	118	
Do	do	Oct. 18, 1940	(1)	17.5	8.6	89.6	1.4	4	7.8	5	126	
Green River, above lock and dam No. 4.	Gr 150	Oct. 9, 1940	250	16.0	7.3	73.2	1.4	2	7.6	10	102	94
Do	do	Oct. 15, 1940	230	14.0	7.6	72.8	.9	1	7.6	15	102	
Do	do	Oct. 21, 1940	200	12.5	7.9	73.8	1.1	1	7.7	13	118	
Beaver Creek, above Glasgow, Ky	GrBBe 252	Oct. 7, 1940	4	17.0	7.4	76.0	1.2	9	7.8	13	164	142
Do	do	Oct. 11, 1940	4	14.0	7.9	76.2	1.6	4	7.7	20	176	
Do	do	Oct. 17, 1940	5	11.0	7.1	64.4	2.0	46	7.6	20	170	
South Fork, Beaver Creek, below Glasgow, Ky.	GrBSBe 240	Oct. 7, 1940	2	16.5	3.0	30.5	103.0	240,000	7.0	130	130	120
Do	do	Oct. 11, 1940	(1)	14.5	0	0	633.0	930,000	7.1	375	298	
Do	do	Oct. 17, 1940	(1)	9.5	3.3	28.5	202.0	230,000	7.5	150	228	
Barren River, bridge on Route No. 13, Scottsville, Ky.	GrB 220	Oct. 10, 1940	64	15.0	8.3	81.9	1.3	2	7.7	10	84	96
Do	do	Oct. 16, 1940	64	12.5	7.5	69.9	.1	2	7.6	13	104	
Do	do	Oct. 22, 1940	59	14.0	8.8	84.8	1.1	1	7.6	10	100	
Bays Fork, below Scottsville, Ky	GrBBf 224	Oct. 10, 1940	(1)	14.0	7.7	74.1	6.0	11,000	7.5	5	186	184
Do	do	Oct. 16, 1940	(1)	12.5	7.1	66.1	10.3	15,000	7.5	15	202	
Do	do	Oct. 22, 1940	(1)	13.5	7.2	68.2	8.6	2,300	7.4	8	186	
Drake Creek, above Franklin, Ky	GrBDWf 231	Oct. 10, 1940	5	12.0	8.3	76.5	2.8	24	7.6	8	148	142
Do	do	Oct. 16, 1940	4	11.0	7.2	65.0	1.6	39	7.7	10	162	
Do	do	Oct. 22, 1940	5	12.0	8.6	79.2	1.5	4	7.6	10	142	
Town Branch, below Franklin, Ky	GrBDWf 228	Oct. 10, 1940	(1)	11.0	0	0	196.0	24,000	6.9	60	222	136
Do	do	Oct. 16, 1940	(1)	9.0	0	0	101.0	93,000	6.9	70	250	
Do	do	Oct. 22, 1940	(1)	9.5	0	0	125.0	9,100	6.8	75	224	
Town Branch, mouth below Franklin, Ky.	GrBDWf 226	Oct. 10, 1940	6	11.0	7.6	68.8	2.0	43	7.7	5	170	136
Do	do	Oct. 16, 1940	5	8.5			2.5	240	7.7	8	146	
Do	do	Oct. 22, 1940	6	9.5	8.3	72.4	1.7	4	7.6	8	164	
Drake Creek, mouth, Bowling Green, Ky.	GrBD 193	Oct. 10, 1940	24	17.5	8.0	82.9	1.4	(1)	7.7	8	144	132
Do	do	Oct. 16, 1940	24	14.0	7.5	72.7	.3	1	7.7	10	142	
Do	do	Oct. 22, 1940	25	18.5	8.8	93.4	1.9	2	7.6	5	144	
Barren River, above Bowling Green, Ky.	GrB 187.5	Oct. 7, 1940	96	16.0	8.5	85.3	1.4	4	7.7	10	122	122
Do	do	Oct. 11, 1940	97	17.5	8.8	91.6	1.2	39	7.7	10	126	
Do	do	Oct. 17, 1940	93	13.5	8.4	80.1	1.5	2	7.7	7	120	

[1] Less than 1.

TABLE GR-7.—*Green River Basin: Ohio River Pollution Survey Laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Pet Milk plant effluent, Bowling Green, Ky.	GrB 178	Oct. 7, 1940	1	17.0	2.3	23.4	97.2	2,400	7.1	110	106	130
Do	do	Oct. 11, 1940	1	20.0	1.8	19.6	89.8	2,300	7.1	75	132	
Do	do	Oct. 17, 1940	1	17.0	2.0	20.5	59.1	930	7.5	70	164	
Barren River, below Bowling Green, Ky.	GrB 176	Oct. 7, 1940	98	18.5	8.4	88.8	2.2	2,100	7.6	10	128	122
Do	do	Oct. 11, 1940	99	20.0	8.2	89.1	2.6	1,500	7.6	10	162	
Do	do	Oct. 17, 1940	95	17.5	7.7	79.9	2.1	430	7.7	7	132	
Barren River, above lock and dam No. 1.	GrB 165	Oct. 8, 1940	100	17.0	6.8	69.6	1.8	1	7.6	10	116	120
Do	do	Oct. 14, 1940	100	24.0	8.3	97.4	1.1	2	7.7	10	126	
Do	do	Oct. 18, 1940	100	18.0	7.8	81.6	2.0	(1)	7.7	95	112	
Gasper Creek, mouth, Bowling Green, Ky.	GrBG 159	Oct. 9, 1940	4	15.0	7.4	72.6	1.5	1	7.6	12	118	122
Do	do	Oct. 15, 1940	4	16.0	7.7	77.5	1.3	2	7.7	20	122	
Do	do	Oct. 21, 1940	3	15.5	8.4	83.8	1.8	1	7.7	8	126	
Barren River, mouth, Woodbury, Ky.	GrB 150	Oct. 9, 1940	110	15.0	7.3	71.7	1.3	1	7.7	102	94	
Do	do	Oct. 15, 1940	110	13.5	7.6	72.2	.8	5	7.6	13	126	
Do	do	Oct. 21, 1940	100	12.0	7.9	72.9	1.4	2	7.7	10	118	
Green River, below Morgantown, Ky.	Gr 141	Oct. 9, 1940	360	10.0	8.3	73.2	2.0	43	7.7	10	100	96
Do	do	Oct. 15, 1940	340	15.5	8.2	81.7	1.0	23	7.5	5	98	
Do	do	Oct. 21, 1940	300	11.5	9.0	81.8	1.8	9	7.7	5	110	
Mud River, below Russellville, Ky.	GrM 156	Oct. 10, 1940	(1)	11.0	0	0	240.0	93,000	7.4	100	416	120
Do	do	Oct. 16, 1940	(1)	10.0	0	0	181.0	93,000	7.1	110	408	
Do	do	Oct. 22, 1940	(1)	9.0	0	0	158.0	93,000	7.1	270	422	
Mud River, mouth, Rochester, Ky.	GrM 110	Oct. 30, 1940		12.5	7.3	68.2	1.2	4	7.5	5	98	94
Do	do	Nov. 4, 1940	(1)	11.5	3.5	31.9	3.0	2	6.9	25	84	
Do	do	Nov. 7, 1940	4	5.5	4.2	32.9	4.6	4	6.8	25	72	
Green River, above lock and dam No. 3.	Gr 109	Oct. 30, 1940	310	11.5	7.2	65.3	.9	2	7.7	8	100	96
Do	do	Nov. 4, 1940	800	12.5	7.5	69.8	2.4	9	7.6	10	108	
Do	do	Nov. 7, 1940	1,100	4.5	8.0	61.8	1.5	4	7.5	10	96	
Green River, above Central City, Ky.	Gr 86	Oct. 30, 1940	320	14.5	7.9	77.4	.8	9	7.7	8	102	102
Do	do	Nov. 4, 1940	850	13.0	8.0	75.7	1.4	4	7.6	8	108	
Do	do	Nov. 7, 1940	1,180	8.0	8.3	70.1	1.1	24	7.5	15	84	

Rough River, above Hartford, Ky.	GrRo 102	Oct. 9, 1940	18	10.5	6.4	57.1	1.7	9	7.1	30	90	76
Do.	do.	Oct. 15, 1940	20	16.0	5.9	59.3	1.3	8	7.3	35	104	
Do.	do.	Oct. 21, 1940	10	9.5	6.0	52.4	2.6	4	7.3	15	126	
Rough River, below Hartford, Ky.	GrRo 99	Oct. 9, 1940	18	10.0	5.8	51.5	2.0	460	7.1	25	94	86
Do.	do.	Oct. 15, 1940	20	13.0	5.5	52.0	1.3	1	7.3	45	102	
Do.	do.	Oct. 21, 1940	10	8.0	5.3	44.6	2.7	460	7.3	20	124	
Muddy Creek, below Beaver Dam, Ky.	GrRoMu 104	Oct. 9, 1940	(1)	8.5	0	0	302	240,000	7.3	100	496	78
Do.	do.	Oct. 15, 1940	(1)	13.0	0	0	142	430,000	7.3	130	456	
Do.	do.	Oct. 21, 1940	(1)	9.0	0	0	132	230,000	7.4	110	460	
Rough River, above lock and dam No. 1.	GrRo 79	Oct. 30, 1940	20	19.5	4.7	50.5	2.3	4	7.3	25	82	
Do.	do.	Nov. 4, 1940	20	15.5	4.6	45.8	1.2	(1)	7.3	25	88	80
Do.	do.	Nov. 7, 1940	20	10.5	5.2	46.4	1.9	2	6.9	45	90	
Green River, above lock and dam No. 2.	Gr 63	Oct. 30, 1940	345	16.0	7.8	78.1	1.2	2	7.7	5	102	
Do.	do.	Nov. 4, 1940	874	16.5	7.4	75.5	.9	2	7.7	10	114	104
Do.	do.	Nov. 7, 1940	1,210	10.5	7.5	66.5	.9	15	7.5	15	96	
Pond River, bridge on Route No. 62, Nortonville, Ky.	GrPo 89	Oct. 29, 1940		20.0	5.0	54.3	3.6	23	6.7	8	26	120
Do.	do.	Nov. 1, 1940	(1)	16.5	6.4	65.2	2.9	3	6.9	10	44	
Do.	do.	Nov. 6, 1940	(1)	9.0	5.3	45.6	1.8	2	6.9	8	38	
Drake Creek, bridge on route 62, Nortonville, Ky.	GrPoD 87.8	Oct. 29, 1940	(1)	19.5	8.4	90.9	[2] .9 1.9	11	3.5	5		880
Do.	do.	Nov. 1, 1940	1	16.0	8.0	80.4	[2] .3 3.7	1	3.5	8		
Do.	do.	Nov. 6, 1940	(1)	9.0	9.7	83.8	[2] 1.8 3.0	(1)	3.1	5		
Flat Creek, below Madisonville, Ky.	GrPoF 80	Oct. 28, 1940	1	24.0	0	0	443.0	93,000	6.9	320	264	
Do.	do.	Oct. 31, 1940	1	19.0	0	0	325.0	1,100,000	7.2	290	304	
Do.	do.	Nov. 5, 1940	1	14.5	4.1	39.7	30.8	43,000	6.9	120	134	124
Cypress Creek, below Central City, Ky.	GrPoC 82	Oct. 30, 1940	(1)	14.0	0	0	19.1	93,000	7.3	40	130	218
Do.	do.	Nov. 4, 1940	(1)	11.5	0	0	20.2	9,100	6.9	20	164	
Do.	do.	Nov. 7, 1940	(1)	7.0	1.6	13.1	24.2	24,000	7.3	35	132	
Pond River, below mouth, Rumsey, Ky.	GrPo 57	Oct. 30, 1940		17.0	7.6	77.5	1.9	4	7.6	25	94	
Do.	do.	Nov. 4, 1940	(1)	15.0	6.8	67.3	2.1	2	7.3	15	82	114
Do.	do.	Nov. 7, 1940	1	9.0	6.9	58.9	3.2	2	6.9	20	52	
Panther Creek, at mouth	GrPa 30	Oct. 30, 1940	3	18.0	6.6	69.4	2.0	2	7.8	8	200	
Do.	do.	Nov. 4, 1940	2	20.0	7.6	83.3	1.5	2	7.7	8	230	
Do.	do.	Nov. 7, 1940	5	12.0	7.4	68.3	2.3	46	7.5	85	154	158
Green River, above lock and dam No. 1.	Gr 9	Oct. 30, 1940	420	16.5	7.9	80.6	1.0	1	7.7	5	106	
Do.	do.	Nov. 4, 1940	1,000	19.0	7.0	75.1	.8	1	7.6	114	108	
Do.	do.	Nov. 7, 1940	1,440	12.5	7.4	69.5	1.2	1	7.6	8	92	

[1] Less than 1.
[2] Seeded and neutralized.

TABLE GR–7.—*Green River Basin: Ohio River Pollution Survey Laboratory data—Summary of individual results*—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Green River, bridge at Spottsville, Ky.	Gr 8.6	Aug. 28, 1940	510	27.0	7.2	89.7	1.2	(1)	7.7	22	104	----------
Do	do	Aug. 31, 1940	1,270	26.5	7.4	90.4	1.7	1	7.7	13	105	----------
Do	do	Sept. 4, 1940	1,510	26.5	6.4	78.6	1.4	1	7.6	18	103	102
Do	do	Oct. 30, 1940	667	18.0	8.4	88.1	.4	1	7.8	13	126	125
Do	do	Oct. 31, 1940	667	17.0	8.1	83.4	.6	(1)	7.7	13	126	----------
Do	do	Feb. 19, 1941	3,150	4.0	12.5	95.4	.6	1	7.6	45	90	----------
Do	do	Feb. 20, 1941	3,350	4.0	12.5	95.0	1.0	2	7.5	70	91	122

[1] Less than 1.

TENNESSEE RIVER BASIN

CONTENTS

	Page
Contents	813
Syllabus and conclusions	815
Description	816
Presentation of field data	818
Presentation of laboratory data	822
Hydrometric data	826
Discussion	829

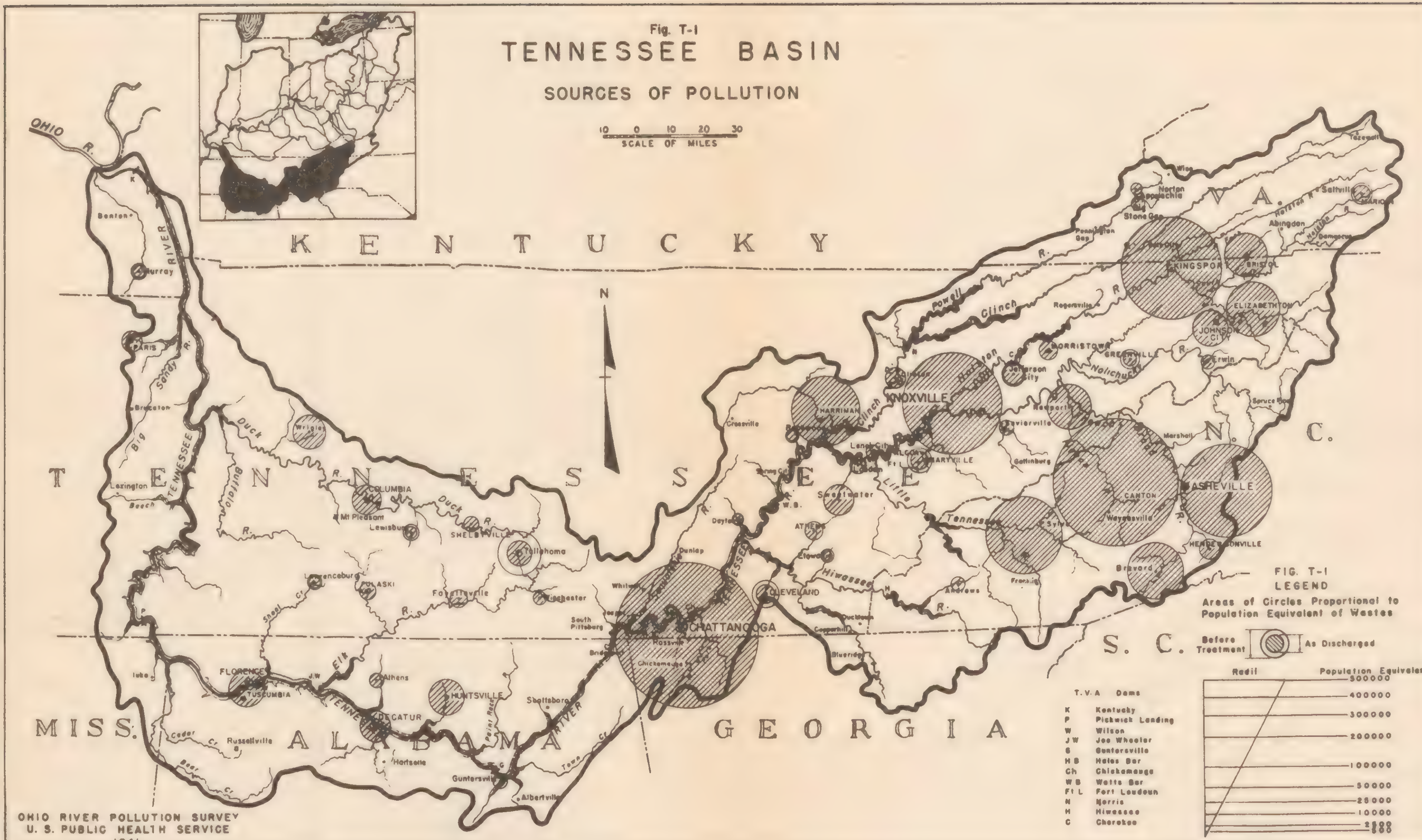
LIST OF TABLES

T-1.—Cost estimates of remedial measures	816
T-2.—Surface water supplies	818
T-3.—Sources of pollution	820
T-4.—Industrial wastes	822
T-5.—Selected laboratory data	823
T-6.—Monthly mean summer flows	828
T-7.—Summary of laboratory data	834
T-7a.—Summary of laboratory data (Tennessee Valley Authority results)	844

LIST OF FIGURES

T-1. Map—Sources of pollution	815
T-2a. Chart—Sources of pollution and selected laboratory data (Tennessee River)	818
T-2b. Chart—Sources of pollution and selected laboratory data (upper tributaries)	818
T-3. Map—Coliform results	822
T-4. Map—Dissolved oxygen results	822
T-5. Map—Biochemical oxygen demand results	822
T-6. Chart—Summer low-flow frequency curve	827

Fig. T-1



(Face p. 815) . GPO-43 O-30035

TENNESSEE RIVER BASIN

Syllabus and Conclusions

SYLLABUS

The Tennessee River Basin drains portions of seven southern States comprising a total area of 40,600 square miles. The larger cities located in the basin are Chattanooga and Knoxville, Tenn., and Asheville, N. C. The area is predominantly rural, with a few highly developed industrial areas. The abundance of good water supplies and natural resources has been influential in the industrial development. Scant progress has been made toward pollution abatement. Known methods of treatment, if applied, would greatly reduce the pollutional load carried by the stream. Additional effort is needed to develop methods of industrial waste treatment for certain major sources of industrial pollution.

CONCLUSIONS

(1) Most of the water supplies in this basin are adequate and dependable. Small supplies are, in general, taken from ground water sources while the larger supplies are from surface waters. In general, water supplies are not seriously affected by pollution, except at Knoxville where industrial wastes from upstream plants have damaged the supply.

(2) Sewage from a population of about 592,000 and industria wastes with a population equivalent of 1,306,000 are produced in this area. Only 20 percent of the domestic sewage receives any treatment and one-third of this treatment is in obsolete and ineffective plants. Existing municipal sewage treatment reduces the combined pollutional load of 1,897,000 to a pollutional equivalent of about 1,833,000 or about 3 percent. In addition, about 20 percent of the waste-producing industries have taken at least minor steps to reduce pollution either by treatment or alteration within the plant.

(3) The more important points where high bacterial pollution was observed were below Asheville and Canton, N. C., and Kingsport, Knoxville, Chattanooga, and Columbia, Tenn. Poor oxygen conditions were found on the Tennessee River below Knoxville and Chattanooga, and on the tributaries the more important points were below Bristol, Copperhill, Cleveland, Kingsport, and Tullahoma, Tenn., and Canton, N. C.

(4) The major sources of pollution are found in the upper half of the basin, principally in Tennessee and North Carolina. A number of sections of tributary streams are grossly polluted, which creates problems that are primarily of a local nature. Conditions on the main river are good except in the vicinity of Knoxville and Chattanooga.

90035—44—pt. 2——43

(5) The expected increase of low-water flow by the Tennessee Valley Authority's stream-control program will improve stream conditions in the main river. Benefits that accrue to stream improvement will largely be intangible but nonetheless desirable.[1]

(6) In view of the normal uses of the streams involved, refined treatment at certain sources of pollution would serve no purpose commensurate with the expenditure. In these instances primary treatment appears justified. A summary of comparative costs of remedial measures from table T–1 follows:

Treatment	Capital cost	Annual charges
Existing	$2, 750, 000	$250, 000
Suggested additional	24, 480, 000	2, 035, 000

Estimated additional costs over existing charges of programs involving uniform treatment throughout the basin are:

Treatment	Capital cost	Annual charges
Primary, all places	$23, 440, 000	$1, 865, 000
Secondary, all places	28, 840, 000	2, 495, 000

TABLE T–1.—*Tennessee River Basin: Estimated cost of existing and suggested minimum corrective measures for municipal and industrial wastes, with comparative costs for primary and secondary treatment*

	Number of plants		Population connected to sewers	Capital investment	Annual charges		
	Primary	Secondary			Amortization and interest	Operation and maintenance	Total
Existing sewage treatment	26	18	98, 400	$2, 750, 000	$170, 000	$80, 000	$250, 000
Suggested minimum correction:							
Sewage-treatment plants	64	37	489, 400	7, 420, 000	520, 000	395, 000	915, 000
Required interceptors				15, 450, 000	725, 000		725, 000
Independent industrial waste correction				1, 610, 000	205, 000	190, 000	395, 000
Total				24, 480, 000	1, 450, 000	585, 000	2, 035, 000
Comparative cost:							
Primary treatment, all waste				23, 440, 000	1, 385, 000	480, 000	1, 865, 000
Secondary treatment, all waste				28, 840, 000	1, 755, 000	740, 000	2, 495, 000
As suggested				24, 480, 000	1, 450, 000	585, 000	2, 035, 000

DESCRIPTION

The Tennessee River is formed by the confluence, in east central Tennessee, of the Holston and French Broad Rivers, whose headwaters are in western Virginia and North Carolina. From this confluence the river flows southwesterly to Guntersville, Ala., thence northwesterly to the northeast corner of Mississippi and finally northward through Tennessee and Kentucky to its confluence with the Ohio River at Paducah. The basin is roughly crescent in shape, somewhat constricted at its center where the river cuts through the

[1] Some of the reservoirs being constructed in connection with the defense program may have an appreciable effect on pollution. Data are not yet available which would permit an evaluation of these effects.

Cumberland Plateau in the vicinity of Chattanooga. The two areas thus formed are approximately equal in size but are dissimilar in physical characteristics. The upper area is mountainous with swift flowing streams and narrow valleys while the lower area is rolling with broad flood plains and sluggish streams.

The drainage area of 40,600 square miles and the 1940 population of 2,941,298 are divided among 7 States as follows:

State	Drainage area, square miles	Population, 1940		
		Urban	Rural	Total
Alabama	6,810	79,464	310,585	390,049
Georgia	1,490	3,538	61,371	64,909
Kentucky	1,055	3,773	43,665	47,438
Mississippi	385	0	15,055	15,055
North Carolina	5,490	67,729	251,230	318,959
Tennessee	22,290	445,337	974,450	1,419,787
Virginia	3,080	32,100	203,001	235,101
Total	40,600	631,941	1,859,357	2,491,298

	Populations			
	1910	1920	1930	1940
Larger cities:				
Chattanooga, Tenn	44,604	57,895	119,798	128,163
Knoxville, Tenn	36,346	77,818	105,802	111,580
Asheville, N. C	18,762	28,504	50,193	51,310
Johnson City, Tenn	8,502	12,442	25,080	25,332
Total basin:				
Urban	212,110	350,270	549,125	631,941
Rural	1,579,533	1,624,770	1,667,953	1,859,357
Total	1,791,743	1,975,040	2,217,078	2,491,298

Major tributaries	River mile	Drainage area, square miles	States
Duck River	110.7	3,560	Tennessee.
Elk River	285.1	2,330	Tennessee, Alabama.
Hiwassee River	499.5	2,660	Tennessee, North Carolina, Georgia.
Clinch River	567.7	4,400	Tennessee, Virginia.
Little Tennessee River	601.3	2,650	Tennessee, North Carolina, Georgia.
French Broad River	652.1	5,140	Tennessee, North Carolina.
Holston River	652.1	3,810	Tennessee, Virginia.

Resources.—The basin is rich in natural resources; tillable land, forest, and water power are abundant. Coal, asphalt, clay, sand and gravel, limestone, phosphate rock, iron, zinc, and copper ore are found in important quantities.

Industries.—While primarily a rural area, over 1,000 industrial plants are found in the basin. Extensive agricultural activity is found, although, in general, it is on a small scale. Practically every type of industry is represented, wood products and textile manufacturing plants predominating. With the advent of cheap power developed by the Tennessee Valley Authority, an increase in industrial developments is anticipated, particularly in the metallurgical field. Dairying shows a significant increase in middle Tennessee.

Water uses.—Climate, character of population, and adequate water supply have been influential in the development of this area. Surface

waters supply the major demands of both industry and domestic users. Ground water supplies are generally used for smaller installations. The Tennessee Valley Authority's development of the river, when complete, will provide for power development, flood protection, and a 9-foot navigation channel from the Ohio River to Knoxville. Recreational facilities are being developed and extensively enjoyed.

Presentation of Field Data

Figures T–2A and T–2B show all sources of pollution of consequence on the Tennessee River and its tributaries. The location, magnitude, and reduction by present treatment of each source of pollution are indicated as well as the location of tributaries, water supply intakes, and other pertinent information. Laboratory data during the months of lowest oxygen concentration, found while sampling, are plotted for four sections of the main stream so that the effect of the indicated sources of pollution may be observed.

Public water supplies.—Of the 244 public water supplies in the basin serving some 871,000 people, 76 are wholly or in part from surface sources; 42 of these are from impounding reservoirs and 11 more are from streams not subject to pollution. The remaining 23 supplies, serving 394,700 people, are from streams subject to varying amounts of pollution. Table T–2 shows data on these supplies.

TABLE T–2.—*Tennessee Basin: Surface water supplies*

Supply	State	Source	Mile [1]	Treatment [2]	Population served	Consumption (million gallons per day)
	Supplies below community sewer outfalls					
Kentucky Dam	Kentucky	Tennessee River [3]	22	FD	800	0.11
Sheffield	Alabama	do	254	FD	14,400	.75
Wilson Dam No. 2	do	do	256.5	FD	3,500	1.30
Decatur	do	do	304.5	FD	16,200	1.00
Guntersville	do	do	357.5	FD	3,500	.27
Bridgeport	do	do.[3]	415	FD	2,100	.08
South Pittsburg	Tennessee	do	418	FD	2,700	.14
Guild	do	do.[3]	431.2	FD	100	.05
Chattanooga	do	do	466	FD	152,000	19.03
Lenoir City	do	Tennessee River, Little Tennessee River.	601.3	FD	4,500	.46
Knoxville	do	Tennessee River	648	FD	120,000	10.00
Columbia	do	Duck River	243	FD	12,000	.74
Shelbyville	do	do	332	FD	7,400	.45
Hiwassee Dam	North Carolina	Hiwassee River	575	FD	200	.06
Harriman	Tennessee	Emory River	584	FD	5,900	.47
Oakdale	do	do	589	FD	400	.02
St. Paul	Virginia	Clinch River	823	FD	700	.02
Richlands	do	do	888	FD	2,200	.09
John Sevier	Tennessee	Holston River	660	FD	200	.01
Morristown	do	Spring, well, Holston River.[3]	731	FD	8,500	.77
Kingsport	do	South Fork, Holston River.[3]	799	FD	17,600	1.30
Bristol	do	do	850	FD	13,000	.95
Greenville	do	Nolichucky River [3]	775	FD	6,800	.58
Total:						
23 Below sewer outfalls					394,700	38.65
53 Other surface supplies					213,800	21.32
Total, surface water supplies					608,500	59.97

[1] Miles above mouth of Tennessee River.
[2] F=Coagulated, settled, filtered; D=Chlorinated.
[3] A part of supply is from ground water sources.

FIGURE T-2A
TENNESSEE RIVER
SOURCES OF POLLUTION
AND
SELECTED T.V.A. LABORATORY RESULTS
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE

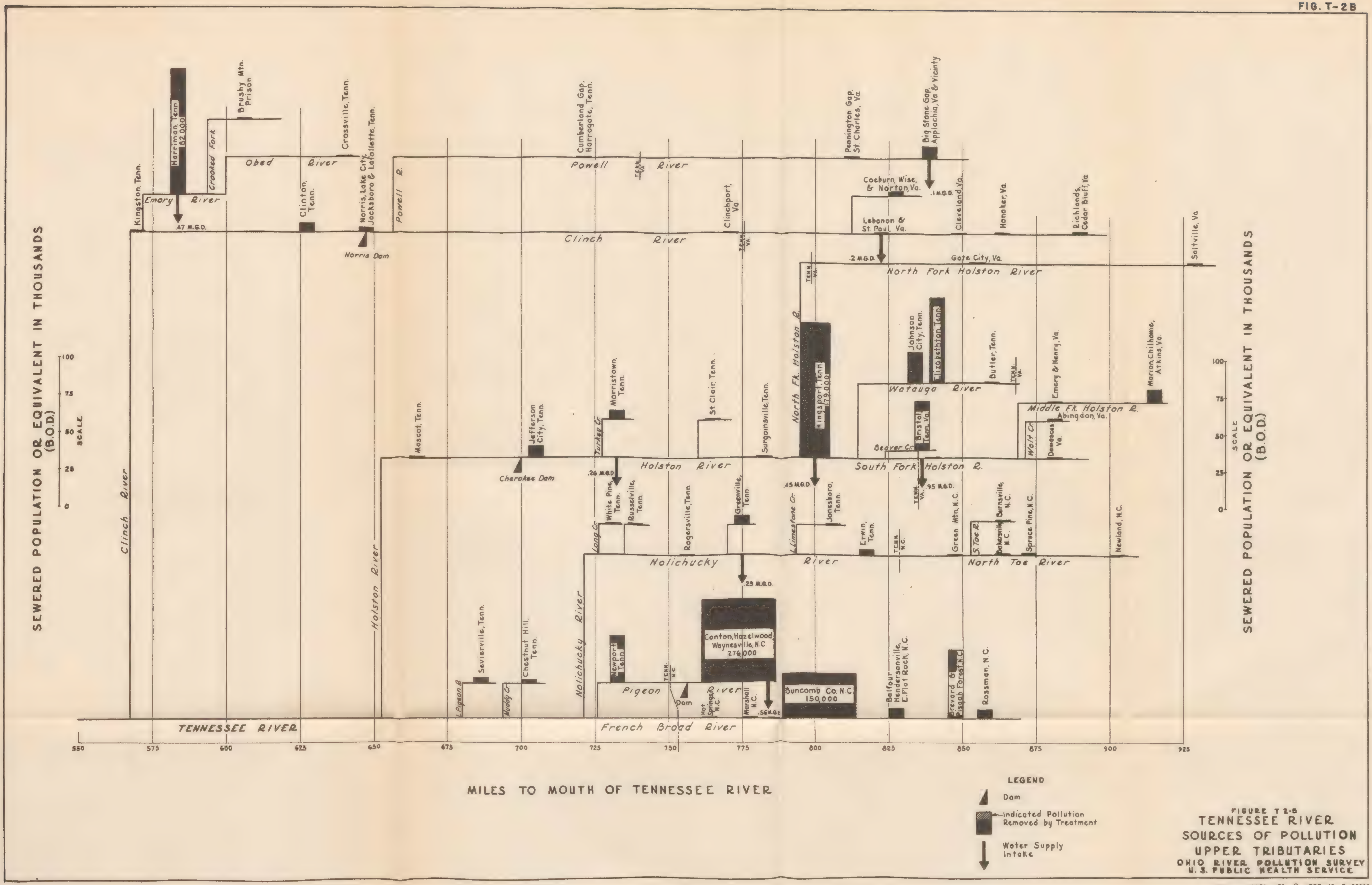


FIGURE T 2-B
TENNESSEE RIVER
SOURCES OF POLLUTION
UPPER TRIBUTARIES
OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE

In general, the water supplies are adequate and have been an important factor in recent industrial growth. The character of supplies obtained from the main river may be expected to change due to transition from river to lake conditions. There will be a tendency for algae to increase and chemical quality to become more uniform. Turbidities will decrease.

Taste and odor troubles have been experienced at Knoxville attributed to industrial wastes.

Sewerage.—There are 170 sewered municipalities in the basin, 44 of which have sewage-treatment plants, other than septic tanks. In general, treatment is found only in the smaller communities that are located on tributaries. Table T–3 summarizes the sewered population together with industrial wastes.

TABLE T-3.—*Tennessee River Basin: Sources of significant pollution including industrial wastes expressed as sewered population equivalent (biochemical oxygen demand)*

Municipality	Tributary	Receiving stream	River mileage from mouth of— Tennessee River	River mileage from mouth of— Tributary	Population connected to sewers	Treatment	Sewered population equivalent (biochemical oxygen demand) Untreated	Sewered population equivalent (biochemical oxygen demand) Discharged
Sheffield, Ala	Tennessee River	Tennessee River	252		5,000	None	5,800	5,800
Florence, Ala	do	do	258		8,300	Tank	11,900	11,900
Wilson Dam, Ala	do	do	258		3,300	Primary	3,300	2,100
Decatur, Ala	do	do	304.5		14,000	None	17,500	17,500
Guntersville, Ala	do	do	357.5		3,000	do	3,000	3,000
Chattanooga, Tenn	do	do	462		102,500	Tank	313,300	313,300
Dayton, Tenn	do	do	504.4		1,200	Primary	2,900	1,900
Loudon, Tenn	do	do	591.6		1,500	None	5,100	5,100
Lenoir City, Tenn	do	do	601.0		2,200	Tank	3,200	3,200
Knoxville, Tenn	do	do	647		90,600	None	171,400	171,400
Murray, Ky	Clarks Run	East Fork	44	42	3,600	Primary	3,900	2,600
Paris, Tenn	Big Sandy River	Baily Fork	107	40	7,100	Tank	7,100	7,100
Wrigley, Tenn	Duck River	Mill Creek	186.6	75.9	0	None	19,300	19,300
Columbia, Tenn	do	Duck River	243.3	132.6	7,400	do	14,200	14,200
Lewisburg, Tenn	do	Big Rock Creek	308	197.4	2,200	Secondary	4,000	600
Shelbyville, Tenn	do	Duck River	332	221.3	3,300	None	4,300	4,300
Tuscumbia, Ala	Tuscumbia Spring Branch	Tuscumbia Spring Branch	252	2	3,000	do	3,000	3,000
Lawrenceburg, Tenn	Shoal Creek	Shoal Creek	323.8	66.1	3,600	Primary	3,800	2,500
Pulaski, Tenn	Elk River	Richland Creek	352.0	66.7	3,200	None	4,400	4,400
Fayetteville, Tenn	do	Elk River	375	90.0	3,600	Tank	4,800	4,800
Winchester, Tenn	do	Boiling Fork Creek	444.7	159.7	2,300	do	3,300	3,300
Tullahoma, Tenn	do	Rock Creek	458.5	173.3	2,700	do	6,000	6,000
Camp Forrest, Tenn	do	do	456.2	171.0	28,000	Secondary	28,000	4,200
Athens, Ala	Swan Creek	Swan Creek	314	13	3,500	None	3,500	3,500
Huntsville, Ala	Huntsville Spring Creek	Huntsville Spring Creek	339.4	18.6	19,100	do	20,200	20,200
Rossville, Ga	Chattanooga Creek	Chattanooga Creek	466.9	6.7	2,000	Primary	51,100	50,400
Chickamauga, Ga	South Chickamauga Creek	South Chickamauga Creek	505.2	37.0	1,200	Tank	7,600	7,600
Fort Oglethorpe, Ga	do	do	481.4	13.2	3,500	Secondary	3,500	500
Cleveland, Tenn	Hiwassee River	South Mouse Creek	532	33.0	7,000	do	12,200	6,300
Athens, Tenn	do	Oostanaula Creek	547.3	47.8	5,700	None	6,300	6,300
Etowah, Tenn	do	Cane Creek	555.0	55.5	2,600	Primary	2,600	1,700
Andrews, N. C	do	Valley River	613.3	113.8	1,500	None	3,600	3,600
Rockwood, Tenn	King Creek	King Creek	556.3	4.4	2,000	Primary	2,600	1,900
Harriman, Tenn	Emory River	Emory River	583	12	3,000	None	82,400	82,400
Clinton, Tenn	Clinch River	Clinch River	627	59	1,600	do	6,800	6,800
Big Stone Gap, Va	Powell River	Powell River	836	180	3,400	do	3,400	3,400

Appalachia, Va	do	do	839	183	2, 500	do	2, 500	2, 500
Sweetwater, Tenn	Sweetwater Creek	Sweetwater Creek	604	19	2, 400	Tank	16, 000	16, 000
Sylva, N. C	Little Tennessee River	Scott Creek	701. 2	99. 7	900	None	99, 600	99, 600
Alcoa, Tenn	Little River	Pistol Creek	648	5	4, 700	Secondary	4, 700	700
Maryville, Tenn	do	do	649	6	5, 800	Primary	6, 000	4, 000
Jefferson City, Tenn	Holston River	Mossy Creek	705. 5	53	1, 000	do	7, 600	7, 300
Morristown, Tenn	do	Turkey Creek	730. 0	79	5, 500	None	6, 800	6, 800
Kingsport, Tenn	do	South Holston River	799	147	9, 600	do	179, 100	179, 100
Johnson City, Tenn	Watauga River	Brush Creek	837	23	20, 300	do	20, 700	20, 700
Elizabethton, Tenn	do	Watauga River	839	25	7, 300	do	53, 900	53, 900
Bristol, Tenn	South Holston River	Beaver Creek	833	39. 8	8, 400	do	9, 900	9, 900
Bristol, Va	do	do	834	40. 8	6, 500	do	23, 500	23, 500
Marion, Va	do	Mouth of Holston River	908	113. 7	7, 000	Primary	7, 000	4, 500
Sevierville, Tenn	Little Pigeon River	Little Pigeon River	684. 5	5. 0	400	None	3, 300	3, 300
Greeneville, Tenn	Nolichucky River	Richland Creek	775. 3	54. 1	5, 200	Secondary	6, 400	2, 600
Erwin, Tenn	do	North Indian Creek	721. 2	90	3, 400	None	3, 400	3, 400
Newport, Tenn	Pigeon River	Pigeon River	733	7	2, 100	do	31, 800	31, 800
Waynesville-Hazelwood, N. C	do	do	782	54	3, 400	do	16, 300	16, 300
Canton, N. C	do	do	789	63	5, 100	do	260, 100	260, 100
Buncombe County, N. C	French Broad River	French Broad River	800	149	67, 500	(1)	151, 300	149, 700
Brevard, N. C	do	do	846	194	2, 300	None	6, 000	6, 000
Rossman, N. C	do	do	868	206	0	do	7, 200	7, 200
Hendersonville, N. C	do	Mud Creek	828	8	5, 100	do	6, 300	6, 300
Pisgah Forest, N. C	do	Davidson River	844. 8	192	0	do	41, 400	41, 400
Small sources (128 towns)					57, 200	Various	77, 200	69, 900
Total					591, 300		1, 897, 300	1, 832, 600

[1] 2 small secondary-treatment plants serve 1,900 population.

Industrial wastes.—Data on 227 waste-producing industrial plants are summarized in table T–4. Pulp and paper industries and chemical plants are the largest producers of industrial pollution. These two types of industry account for over half of the basin's pollution load and constitute the major problem of pollution control. The sewered population equivalent of industrial waste discharged to municipal sewers is 123,500 or about 10 percent of the total industrial waste.

TABLE T–4.—*Tennessee River Basin: Summary of Industrial Wastes not Discharging to municipal treatment plants, with total of entire industrial waste load in the basin*

Industry	Number of plants	Industrial waste disposal		At least minor corrective measures taken	Estimated sewered population equivalent (biochemical oxygen demand)
		Municipal sewers	Private outlet		
Cannery	24	6	18	2	38, 400
Chemical	21	2	19	11	353, 200
Meat	19	11	8	2	40, 200
Milk	26	17	9	2	9, 500
Pulp and paper	9	2	7	8	584, 400
Tannery	9	2	7	2	79, 900
Textiles	80	37	43	1	138, 700
Miscellaneous	39	4	35	13	56, 300
Waste unconnected municipal treatment	227	81	146	41	1, 300, 600
Wastes discharged to municipal treatment					5, 400
Total industrial waste in the basin					1, 306, 000
By States:					
Alabama					9, 400
Georgia					57, 000
Kentucky					300
Mississippi					0
North Carolina					508, 500
Tennessee					712, 500
Virginia					18, 300

PRESENTATION OF LABORATORY DATA

Complete summaries of laboratory results for the Tennessee River Basin are presented in tables T–7 and T–7A (pp. 834 and 844). A part of the laboratory observations for the Tennessee Basin was carried out by two mobile laboratory units during November 1940, and January, February, and March 1941.

Since 1936 extensive stream pollution studies of the Tennessee River Basin have been carried on by the Tennessee Valley Authority in cooperation with the several States that make up this area. A report titled "Studies of the Pollution of the Tennessee River System," was published in February 1941, and it is anticipated that subsequent reports will be made.

From March 1939 to February 1941, the Ohio River pollution survey actively cooperated with the Tennessee Valley Authority in their pollution studies. Data collected prior to 1939 have been made available to the Ohio River pollution survey and have been freely used in this report. Included with these data were chemical results on Duck River samples analyzed by the Tennessee Department of Health.

(Face p. 822) No. 1 GPO-43 O-88035

Fig. T-3

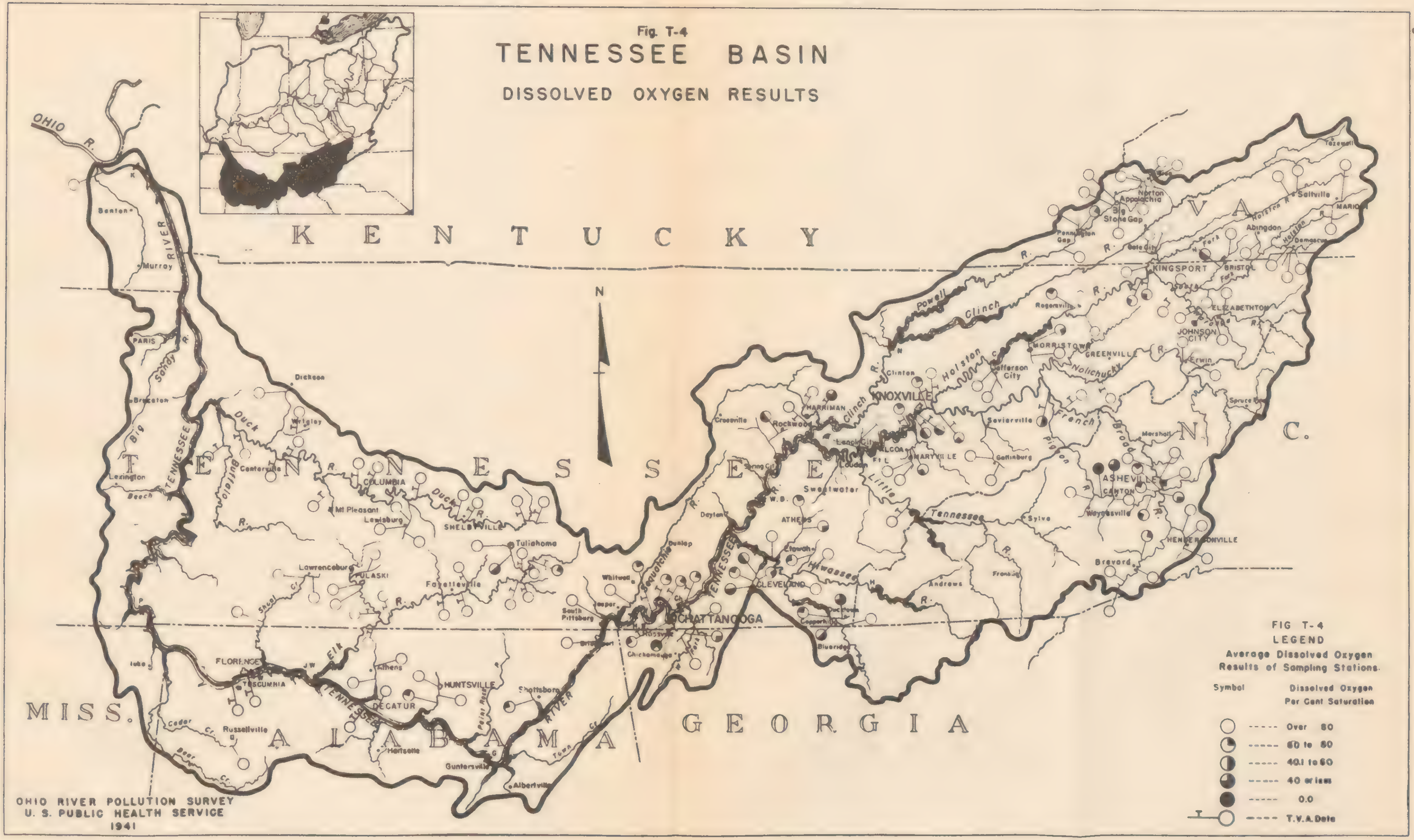


Fig. T-4

(Face p. 822) No. 2 GPO-43 0-9035

(Face p. 822) No. 3 GPO-43 0-9935

Fig. T-5

Selected monthly average laboratory results at some of the principal points in the basin are tabulated with flows on sampling days and the minimum monthly flows of record in table T–5. Selected results have been chosen for low dissolved oxygen or high coliform findings and, in general, represent the most unfavorable conditions during sampling.

TABLE T–5.—*Tennessee River Basin: Selected laboratory data*

MAIN RIVER—MOST UNFAVORABLE DISSOLVED OXYGEN RESULTS

River	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee
Location	Above Knoxville, Tenn.	At Knoxville, Tenn.	Below Knoxville, Tenn.	Below Knoxville, Tenn.	Above Chattanooga, Tenn.	Below Chattanooga, Tenn.	Below Chattanooga, Tenn.
River miles above mouth of Tennessee	650.5	645.5	638.9	625.1	472.1	460.8	452.2
Period, 1936	August	August	August	August	July	July [1]	July
Number of samples	3	3	3	3	4	4	4
Flow in cubic feet per second:							
Sampling days	4,500	4,500	4,300	4,600	15,800	16,200	16,500
Minimum month	1,830	1,830	1,830	1,830	...	...	...
Water temperature, °C	28.3	29.2	29.3	29.0	28.4	28.4	28.5
Coliforms, per milliliter	33	650	900	75	23	700	425
Dissolved oxygen, parts per million	5.72	5.14	4.39	4.95	5.91	6.03	5.56
Biochemical oxygen demand 5-day, parts per million	1.12	1.57	1.32	1.20	1.24	1.04	1.29

River	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee
Location	Above Decatur [1]	Below Decatur [1]	Below Decatur [1]	Above Florence	Below Tuscumbia	Below Tuscumbia	Below Nortons Bluff Bridge
River miles above mouth of Tennessee	307.6	302.5	296.0	256.6	251.8	241.5	5.3
Period, 1937	June [1]	June [1]	June [1]	August	August	August	September 1940
Number of samples	5	5	5	3	4	3	4
Flow in cubic feet per second:							
Sampling days	23,400	23,400	23,400	25,200	26,400	25,200	26,300
Minimum month	...	...	...	3,760	...	...	5,070
Water temperature, °C	27.7	28.0	28.0	28.8	28.9	28.7	22.3
Coliforms, per milliliter	22	38	26	([1])	27	7.7	([2])
Dissolved oxygen, parts per million	6.91	6.78	6.97	7.43	7.08	6.78	8.2
Biochemical oxygen demand, 5-day, parts per million	.86	1.13	1.32	0.98	1.10	0.93	0.8

MAIN RIVER—MOST UNFAVORABLE COLIFORM RESULTS

River	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee
Location	Above Knoxville	At Knoxville	Below Knoxville	Below Knoxville	Below Loudon	Above Chattanooga	Below Chattanooga
River miles above mouth of Tennessee	650.5	645.5	638.9	625.1	591	472.1	457.1
Period	October 1936	June 1936	September 1936	July 1936	February 1941	January 1937	September 1936
Number of samples	4	4	4	3	3	2	2
Flow in cubic feet per second:							
Sampling days	15,100	5,200	4,200	6,700	9,080	121,000	14,200
Minimum month	1,830	1,830	1,830	1,830	2,860	3,990	3,990
Water temperature° C	17.6	27.0	26.6	26.7	5.0	12.0	26.0
Coliforms, per milliliter	170	1,800	2,000	325	11	100	2,200
Dissolved oxygen, parts per million	7.51	6.34	4.42	5.84	11.0	9.57	6.25
Biochemical oxygen demand, 5-day, parts per million	2.69	1.68	1.88	1.10	3.5	1.42	.82

[1] Also worst coliform month. [2] Less than one.

TABLE T-5.—*Tennessee River Basin: Selected laboratory data*—Continued

MAIN RIVER—MOST UNFAVORABLE DISSOLVED OXYGEN RESULTS—continued

River	Tennessee	Tennessee	Tennessee	Tennessee	Tennessee River		Tennessee
Location	Below Chattanooga	South Pittsburg	Bridgeport	Above Florence	Below Tuscumbia		Nortons Bluff Bridge
River miles above mouth of Tennessee	452.2	418	414	256.6	251.8	241.5	5.3
Period	September 1936	February 1941	February 1941	May 1937	June 1937	June 1937	November 1940
Number of samples	2	3	3	4	4	4	4
Flow in cubic feet per second:							
Sampling days	14,200	13,100	13,100	63,000	22,400	22,400	24,200
Minimum month	3,990	----------	----------	3,760	----------	----------	5,070
Water temperature, °C	26.5	6.5	6.3	20.8	26.1	25.9	18.9
Coliforms, per milliliter	2,400	16	20	5.8	8.5	120	4
Dissolved oxygen, parts per million	6.24	10.8	10.8	9.52	8.31	7.97	10.2
Biochemical oxygen demand, 5-day, parts per million	1.0	1.7	2.1	1.25	1.34	1.20	.7

TRIBUTARIES

River	Powell	South Holston	North Holston	Watauga	Watauga	South Holston	Holston
Location	Below Big Stone Gap	Below Bristol	At Kingsport	Below Elizabethton	Below Johnson City	Below Kingsport	At mouth
River miles above—							
Confluence with Tennessee River	163	168	142	188	177	143	0.1
Mouth of Tennessee	815	820	794.5	840	829	795	652.2
Period, 1937	March 1941	August	August	March 1941	August	August	January
Number of samples	3	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	211	940	600	1,398	970	2,360	19,500
Minimum month	----------	----------	----------	----------	----------	----------	795
Water temperature, °C	3.8	24.2	23	6.3	25.5	26.3	10.8
Coliforms, per milliliter	280	250	23	357	240	950	43
Dissolved oxygen, parts per million	12.8	6.7	7.5	6.3	6.4	4.6	9.85
Biochemical oxygen demand, 5-day, parts per million	3.0	1.5	.9	9.9	1.4	6.8	2.58

River	French Broad	French Broad	French Broad	Pigeon	Pigeon	Pigeon	Pistol Creek
Location	At mouth	Above Asheville	Below Asheville	Above Canton	Below Canton	At Newport	Below Alcoa
River miles above—							
Confluence with Tennessee River	0.4	152	133	139	137	81	12
Mouth of Tennessee	652.5	804	785	791	789.5	733	647
Period	October 1936	March 1941	March 1941	March 1941	March 1941	August 1937	February 1941
Nunber of samples	3	1	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	11,000	903	1,017	128	128	580	28
Minimum month	1,125	----------	328	----------	----------	158	7
Water temperature, °C	17.1	1.0	3.2	1.2	4.3	23.7	7.8
Coliforms, per milliliter	375	24	438	14	1,040	1,600	1,420
Dissolved oxygen, parts per million	7.39	11.0	10.9	12.4	0.9	0.9	7.7
Biochemical oxygen demand, 5-day, parts per million	2.25	1.8	2.7	1.3	238	7.7	6.6

TABLE T-5.—*Tennessee River Basin: Selected laboratory data*—Continued

TRIBUTARIES—Continued

River	Clinch	Hiwassee	Ocoee	Ocoee	Sequatchie	Roseberry Creek	Spring Creek
Location	At mouth	At Charleston	Below Copperhill	At mouth	At mouth	Below Scottsboro	3 miles below Huntsville
River miles above—							
Confluence with Tennessee River.	1	15	68	35	----------	1	16
Mouth of Tennessee	569	515	568	535	423	383	337
Period, 1941	August 1937	February	February	February	February	February	January
Number of samples	2	3	3	3	3	3	3
Flow in cubic feet per second:							
Sampling days	2,080	1,600	169	602	430	8	54
Minimum month	400	----------	----------	----------	----------	----------	----------
Water temperature, °C	22	3.0	5.0	4.5	6.8	5.0	8.5
Coliforms, per milliliter	350	1	([2])	1	([2])	1,980	363
Dissolved oxygen, parts per million	6.02	11.9	6.4	11.6	11.4	8.4	8.2
Biochemical oxygen demand, 5-day, parts per million	3.49	0.7	[1] 6.0	0.6	0.7	45	2.2

River	Swan Creek	Richland Creek	Rock Creek	Rock Creek	Elk	Duck	Duck
Location	Below Athens, Ala.	Below Pulaski	Below Tullahoma	Below Lewisburg	Below Fayetteville	Below Shelbyville	Below Columbia
River miles above—							
Confluence with Tennessee River.	11	66	172	196	88	216	130
Mouth of Tennessee	311	351	457	306.5	373	326	240
Period	January 1941	January 1941	February 1941	January 1941	August 1938	July 1938	August 1938
Number of samples	3	3	3	3	2	2	5
Flow in cubic feet per second:							
Sampling days	90	501	5	67	819	318	1,180
Minimum month	----------	30	----------	----------	115	83	39
Water temperature, °C	8.5	8.8	5.0	8.5	26	26.5	28.4
Coliforms, per milliliter	817	337	7,030	410	31	300	600
Dissolved oxygen, parts per million	9.6	10.8	6.9	10.2	6.9	6.2	5.7
Biochemical oxygen demand, 5-day, parts per million	3.0	3.8	34.2	2.9	1.3	1.2	1.7

[1] Seeded and neutralized. [2] Less than 1.

Figures T-3 and T-4 show the distribution of coliform bacteria and dissolved oxygen, respectively, at the various sampling points throughout the basin, as based on average results during the most unfavorable month of observations at each point. In general, the higher coliform results tended to occur during months of high stages, whereas the lower dissolved oxygen results coincided with lower stream flows and high temperatures.

As indicated by bacteriological findings, over 90 percent of the sampling stations not immediately below sources of pollution showed coliform organism concentrations of less than 200 per milliliter. The more important points where high coliform results were found are below Asheville and Canton, N. C., and Kingsport, Knoxville, Chattanooga, and Columbia, Tenn.

Poor oxygen conditions were found on the Tennessee River below Knoxville and Chattanooga and on the tributaries below Bristol, Canton, Copperhill, Cleveland, Tullahoma, Harriman, Kingsport, and Sylva. The low oxygen results found below Bristol, Copperhill, Canton, Harriman, Kingsport, and Sylva are largely due to industrial wastes.

Acid stream conditions were observed in the vicinity of Copperhill on the Ocoee River.

Figure T–2 shows dissolved oxygen, 5-day biochemical oxygen demand, and coliform results for sections of the main river at Knoxville, Chattanooga, Decatur, and Florence. These data were chosen for the month showing the most unfavorable dissolved oxygen conditions. These results are typical of a stream receiving pollution and show the effect of natural stream recovery.

Figure T–5 shows the results of biochemical oxygen demand analyses at the various sampling stations throughout the basin, and reflects the quantity of unstable organic material that must be oxidized.

Hydrometric Data

Two hundred and thirty stream gaging stations have been maintained on the Tennessee River Basin for varying periods, 158 stations of which are active at the present time. Eight stations of importance from the pollution standpoint have been selected and the monthly mean summer flows for the 3 years in which the lowest summer flows have occurred are presented in table T–6.

Figure T–6 presents low-flow frequency curves of the minimum monthly mean flows from June to September, inclusive, for the French Broad River at Dandridge and for the Pigeon River at Newport. These curves indicate that the expectancy of low monthly mean summer flows is as follows:

Location	Minimum monthly mean summer flows in cubic feet per second that may be expected once in—			
	2 years	5 years	10 years	Minimum
Newport, Tenn.	500	360	320	158
Dandridge, Tenn.	3,280	2,320	2,000	973

With the completion of the proposed dams in the Tennessee River Basin, the Tennessee Valley Authority estimates the expected minimum weekly average controlled flows (May through September) to be as follows: [2]

Location	Miles above mouth	Flow in cubic feet per second	
		Typical dry year	Typical wet year
Knoxville	648		
Fort Loudon Dam	591	4,750	5,250
Watts Bar Dam	530	11,600	17,250
Chickamauga Dam	471	14,900	19,850
Chattanooga	461		
Hales Bar Dam	431	15,500	20,700
Guntersville Dam	349	16,400	25,200
Wheeler Dam	275	17,700	27,800
Wilson Dam	259	18,300	28,400
Pickwick Dam	207	19,900	30,400

[2] Additional reservoirs now under construction in connection with the defense program will further increase these flows.

Fig. T-6

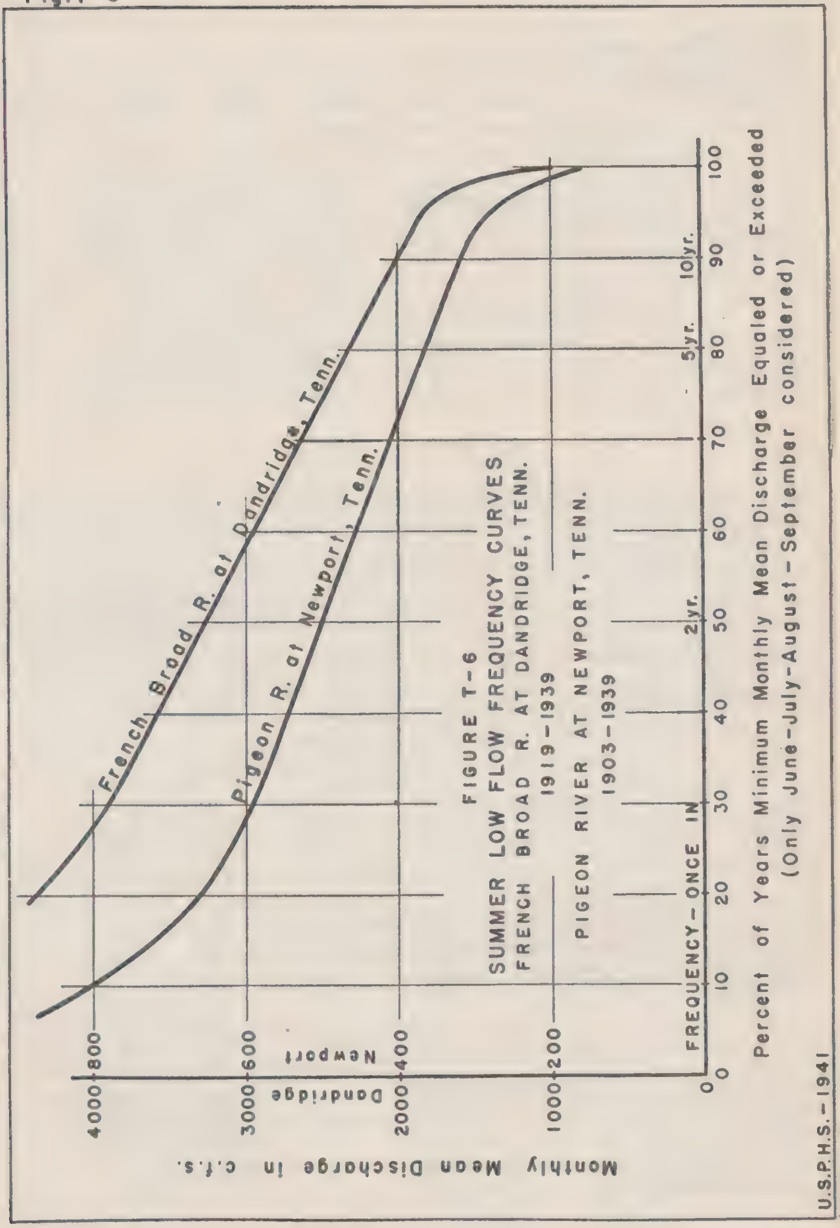


FIGURE T-6
SUMMER LOW FLOW FREQUENCY CURVES
FRENCH BROAD R. AT DANDRIDGE, TENN.
1919-1939
PIGEON RIVER AT NEWPORT, TENN.
1903-1939
French Broad R. at Dandridge, Tenn.
Pigeon R. at Newport, Tenn.
Monthly Mean Discharge in c.f.s.
Dandridge
Newport
4000 3000 2000 1000 0
800 600 400 200
0 10 20 30 40 50 60 70 80 90 100
FREQUENCY - ONCE IN
2 yr.
5 yr.
10 yr.
Percent of Years Minimum Monthly Mean Discharge Equaled or Exceeded
(Only June-July-August-September considered)
U.S.P.H.S.-1941

TABLE T-6.—*Tennessee River Basin; Monthly mean summer flows for years in which low summer flows have occurred*

River	Tennessee	Tennessee	Tennessee	South Fork, Holston
Location	At Knoxville	At Chattanooga	At Johnsonville	At Kingsport
River miles above—				
Confluence with Tennessee				148
Mouth of Tennessee	648	468	100	800
Drainage area (square miles)	8,934	21,400	38,520	1,931
Period of record	1900–40	1874–40	1890–40	1925–40
Year	1904	1881	1897	1930
June cubic feet per second	6, 660	19, 600	26, 400	911
July do	5, 980	12, 400	32, 200	662
August do	6. 460	8, 080	24, 100	1, 050
September do	3, 290	14, 500	11, 500	736
Year	1925	1883	1903	1932
June cubic feet per second	4, 790	25, 300	66, 800	1, 710
July do	3, 960	15, 700	26, 900	1, 330
August do	[1] 1, 830	10, 500	20, 700	900
September do	1, 850	7, 610	11, 200	[1] 630
Year	1932	1925	1925	1939
June cubic feet per second	8, 240	10, 800	14, 600	1, 409
July do	7, 550	9, 370	13, 600	1, 842
August do	5. 200	4. 760	8. 130	1, 295
September do	3, 130	[1] 3, 990	[1] 4, 780	634

River	Pigeon	French Broad	Little Tennessee	Emory
Location	Newport	Dandridge	At McGee	Oakdale
River miles above—				
Confluence with Tennessee	6	45	19	21
Mouth of Tennessee	732	697	620	589
Drainage area (square miles)	655	4,446	2,443	758
Period of record	1903–29	1919–40	1905–40	1930–40
Year	1914	1919	1914	1930
June cubic feet per second	603	5, 820	2, 660	64
July do	461	4, 740	2, 680	20
August do	534	3, 310	2, 260	8
September do	308	1, 770	1, 620	13
Year	1919	1925	1919	1935
June cubic feet per second	843	2, 240	4, 720	386
July do	927	2, 030	3, 610	105
August do	643	981	2, 720	108
September do	313	[1] 973	1, 420	[1] 6
Year	1925	1932	1925	1936
June cubic feet per second	457	4, 670	2, 400	16
July do	328	3, 750	1, 850	48
August do	[1] 158	3, 010	1, 140	30
September do	180	1, 770	609	24

[1] Minimum month.

Discussion

Due to the rural character of the Tennessee River Basin, there are large areas where problems of pollution are of a minor nature. In many sections of the basin, high-stream flows lessen the effects of pollution

There are a few highly developed industrial areas and pollution problems of consequence are primarily the result of industrial wastes. Only at Chattanooga and Knoxville, Tenn., and at Asheville and vicinity in North Carolina does sewage account for an appreciable portion of pollution problems of more than local significance. Even at these places, industrial wastes are at least equally important with sewage and at Chattanooga, industrial waste dominates the situation.

Pollution problems of consequence, due almost entirely to industrial wastes, exist at and below Harriman and Kingsport, Tenn., and on the Pigeon River in North Carolina and below in Tennessee.

Minor pollution problems, of local significance only, exist at a number of moderate sized and small communities on minor streams. Corrective measures at these points are included in the cost estimates but discussion has been omitted.

TENNESSEE RIVER

The nine dams located on the main stream make the river essentially a chain of lakes. These dams have reduced the river velocity, resulting in the settling out of solids and a decrease in turbidity. The consequent increase in light penetration has stimulated biological activity and this phenomenon has been charged with bringing taste and odor troubles to water plants. The pooling of the river has undoubtedly caused an increased formation of sludge banks in the vicinity of sewer outfalls.

Chattanooga.—The metropolitan area is the most highly industrialized area of the basin. A pollutional load of 373,000 population equivalent is discharged to the stream, of which 268,000 is contributed by industry. Chattanooga Creek which receives waste from Rossville, Ga., and the southern part of Chattanooga (population equivalent 228,000) is probably the most highly polluted stream in the basin. Floating oil, scum, color, and septic conditions have made the stream a disgrace. Offensive odors are prevalent and cause local nuisances. The water of Chattanooga Creek is unfit for domestic purposes and most industrial uses and, in addition, pollutes the main river for a considerable distance downstream promoting conditions adverse to further industrial development.

Laboratory findings show dissolved oxygen in the stream falls to 5.5 parts per million and it is indicated that values less than this will be found with lower flows. Below the city, coliform organisms in the main river were found to be in excess of 200 per milliliter for 50 percent of the months sampled.

Little effort is being made to treat wastes in this area and existing works are either overloaded or not in operation. Unsightly conditions exist near all sewer outlets; discoloration and floating materials are common. The water supply intake is located above nearly all of the local pollution. Difficulties experienced in water treatment have been caused by pollution originating as far upstream as Saltville, Va.

Primary treatment works are amply warranted for the prevention of sludge banks and the elimination of floating material. Some benefit to pollution abatement may accrue from the control of low water flow by upstream reservoirs.

Knoxville.—This city's wastes have a population equivalent of 171,000, of which 81,000 is attributed to industrial waste. There is no treatment of wastes either domestic or industrial. This load of pollution taxes the river's capacity for recovery and records show dissolved oxygen falling to 4.0 parts per million. Below the city coliform organisms have averaged 650 per milliliter during the summer months. Unsightly floating material is found below the city and septic conditions with resultant odor nuisances may be expected with minimum flows. In view of the present conditions and future possibilities, primary treatment of all wastes should be installed.

The water supply for the city of Knoxville is at times damaged by industrial wastes from upstream plants. This is the most serious condition in the entire basin. During low flows these industrial wastes give the water a high color, create excessive chlorine demands, and cause taste and odor troubles. Low flows are usually encountered during the fall and early winter.

FRENCH BROAD RIVER

This stream and its tributaries drain 13 percent of the total basin, receive 34 percent of the industrial pollution load and 29 percent of the total pollution load. Practically all of the pollution on this watershed arises in North Carolina. No treatment of domestic sewage is practiced and only isolated instances of industrial waste treatment are found. Water supplies, in general, are obtained from the headwaters of the streams so there is little damage to the supplies from wastes. However, the main stream is rendered unsuitable for either domestic or many industrial uses.

Pigeon River.—This stream is the principal waste-carrying tributary, receiving a pollutional load of 309,000 population equivalent, of which 298,000 is from industrial wastes. For almost its entire length this stream is grossly polluted from paper mills, tanneries, and canneries. In color the stream is inky black with quantities of yellowish brown foam on its surface. At times the dissolved oxygen approaches zero and the chlorine demand is high. The effect of wastes discharged to this stream has caused trouble at the Knoxville water plant. During low flows a high color carried over to the filters and the chlorine demand taxed equipment capacity. In addition, real-estate values of riparian property have been damaged by the appearance of the stream. One tannery gives preliminary treatment to its industrial waste by sedimentation which greatly reduces its load on the stream. A further reduction of the polluting materials discharged to the Pigeon River is imperative. The problem is difficult of solution because of paper mill waste. A preliminary step that should be taken and one which will probably be included in the ultimate solution of the problem is sedimentation of all wastes from the paper mills, tanneries, and canneries. Increased research in treatment processes with a view of possible recovery of valuable byproducts is amply justified.

Asheville, N. C., and vicinity.—Buncombe County, of which Asheville is the county seat, is located along the French Broad River and contributes a pollutional load of 150,000 sewered population equivalent. This county is extensively sewered and practically all wastes not originating on the river banks are discharged to public sewers. Industrial wastes are contributed by rayon, textile, and meat-packing establishments. None of the wastes are treated and the condition of the stream is such that it is not used for either water supply or recreation. Primary treatment of all wastes to remove color, floating material, and solids is indicated.

Brevard, N. C.—Pollution of the French Broad is most serious in this vicinity where industrial wastes from the manufacture of paper, tannic acid, and leather have discolored the stream for many miles. Treatment to remove this color is desirable from an aesthetic standpoint and to make the stream usable for water supply and recreation. One tannery in this vicinity uses sedimentation to reduce the strength of its industrial waste.

HOLSTON RIVER

This stream and its tributaries receive a pollutional load of 316,000 population equivalent of which 247,000 is contributed by industrial wastes. Major water supplies are obtained from the river, many of them downstream from large sources of pollution. Recovery of the stream due to natural purification leaves the water at the mouth generally suitable for domestic and most industrial water supplies. Hardness, added by industrial wastes, causes damage for some distance but becomes less objectionable with increased flow in the lower reaches of the river. Nuisance conditions exist in the immediate vicinity of the larger towns.

Kingsport, Tenn.—In and below this city is found the most grossly polluted section of the Holston River. Here it receives the industrial wastes from a rayon and wood products plant, a paper mill and other miscellaneous establishments, in addition to untreated domestic sewage. The river in this section contains considerable floating and suspended matter and presents an unsightly appearance. One large water supply for a paper mill is taken from this polluted section. Remedial measures should be taken to reduce the pollutional load. Primary treatment of domestic sewage by tried methods is indicated. Industrial waste treatment would probably involve segregation of wastes, chemical precipitation and evaporation of strong wastes.

Elizabethton, Tenn.—At this city all wastes are discharged directly to the Watauga River, a tributary of the Holston River. Industrial wastes from the manufacture of rayon contribute a population equivalent of 47,000. By a revision of plant operation and the installation of copper recovery apparatus, one plant has reduced the amount of iron being discharged to the stream with a subsequent improvement in appearance. Viscose rayon waste is passed through basins to neutralize and settle out fiber. There is no treatment of domestic waste and odor nuisances exist in the vicinity of outfalls. Primary treatment of domestic waste and further treatment of the viscose rayon waste is indicated.

90035—44—pt. 2——44

The mining and washing of manganese ore has discolored the Watauga River. This situation could be remedied by settling and recirculation of wash waters.

Saltville, Va.—Industrial wastes of a chemical nature are discharged and add hardness to the North Fork of the Holston River. Treatment by settling removes quantities of solids and under usual conditions dilution is sufficient to care for the effluent. However, on at least two occasions retaining walls have broken, releasing accumulated sludge. This material, high in chlorides, killed fish and caused difficulties with the operation of downstream water supplies. The recurrence of these conditions should be guarded against by proper construction of treatment works.

LITTLE TENNESSEE RIVER

The only major problem on this tributary is found at Sylva, N. C., where the untreated wastes from a paper mill, a tannery, and a tannic-acid plant grossly pollute the stream. Conditions encountered are typical, brown or black color, foam, high organic and low oxygen content, and the usual odors. Physical conditions are favorable for natural purification of the stream but are not sufficient to eliminate the nuisance conditions that prevail for many miles downstream. Plant operations should be revised to permit a minimum of pollutional matter to reach the stream.

CLINCH RIVER

This river drains a rural area and, in general, the pollution problems are of minor importance and of local interest only. Harriman, Tenn., on the Emory River, a tributary of the Clinch, presents the only major problem. Industrial wastes from textile plants and a paper mill have a population equivalent of 79,000 and tax the recovery capacity of the river. During low flows, the river is highly colored and septic conditions exist. There is no treatment of wastes. Conditions may be aggravated when backwater from Watts Bar Dam reduces the velocity of the river so that pollution is not rapidly carried downstream. A reduction of the pollutional load is warranted. This could be accomplished by treating textile and domestic wastes by proven methods and a revision of paper-mill operation so that a minimum of waste is discharged.

HIWASSEE RIVER

The mining of copper and iron and the manufacture of sulfuric acid near Copperhill, Tenn., release large amounts of inorganic and chemical substances to the river. A load of 136 tons of suspended solids is discharged daily. Many of the solids discharged come from the settling ponds that receive the tailings from the flotation process. The manufacturer is attempting to neutralize the acidity of the waste by the addition of lime so that the stream is not corrosive to metallic structures downstream. The large amount of suspended solids has colored the stream a reddish brown with a floc-like precipitate apparent just below the surface. On reaching Parksville Reservoir, the

solids settle out and are gradually filling up the lake. Conditions are aggravated during rains due to excess erosion of the denuded soil. As the stream leaves the Parksville Dam, it has practically recovered from the effects of organic pollution. It is suggested that neutralization of waste be continued and additional efforts made to keep solids out of the river.

ELK RIVER

None of the larger communities on this watershed employs sewage treatment and consequently local nuisance conditions exist below some outfall sewers. There is a history of fish being killed by spills, presumably accidental, of strong waste.

Camp Forrest, Tenn.—This new military camp has taken measures to insure against causing nuisance conditions. Secondary treatment of sewage with provision for chlorination of the effluent has been provided. Despite these precautions, some trouble has been experienced primarily because of a growth to a full load that was not anticipated.

Estimates of cost of suggested remedial measures have been presented in table T–1.

TABLE T-7.—*Tennessee River Basin: Ohio River pollution survey laboratory data*

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent saturation						
North Fork, Holston River, 1 mile above Saltville, Va.	TeHoNf 880	Feb. 28, 1941	74	1.0	13.7	96.4	1.9	(1)	7.5	5	99	72
Do	do	Mar. 6, 1941	148	2.0	13.0	93.6	2.2	8	7.4	5	66	
Do	do	Mar. 12, 1941	1,640	5.0	12.1	94.2	1.4	24	7.2	69	42	
North Fork, Holston River, below alkali works, Saltville, Va.	TeHoNf 877	Feb. 28, 1941	74	4.0	11.8	89.9	4.3	15	8.8	61	119	62
Do	do	Mar. 6, 1941	148	4.0	12.4	94.1	1.5	4	7.9	10	73	
Do	do	Mar. 12, 1941	1,640	5.0	12.1	94.8	2.1	36	7.2	75	42	
Little Moccasin Creek corporate limits above Gate City, Va.	TeHoNfLm 810	Mar. 3, 1941	3	7.5	13.2	110.0	2.1	15	8.1	5	186	131
Do	do	Mar. 7, 1941	60	7.0	11.4	93.5	4.3	93	7.4	1,700	107	
Do	do	Mar. 13, 1941	10	7.0	11.3	93.0	2.1	110	7.7	25	143	
Little Moccasin Creek corporate limits below Gate City.	TeHoNfLm 808	Mar. 3, 1941	3	7.0	12.4	102.1	15.3	2,400	7.9	10	197	141
Do	do	Mar. 7, 1941	60	7.0	11.2	91.9	5.1	230	7.4	1,600	133	
Do	do	Mar. 13, 1941	10	6.5	11.1	89.9	3.2	150	7.7	20	152	
North Fork Holston River, 3 miles north of Kingsport, Tenn.	TeHoNf 702	Mar. 3, 1941	775	7.0	13.1	107.6	2.1	1	7.7	5	96	765
Do	do	Mar. 7, 1941	4,280	5.0	12.1	94.4	2.5	24	7.6	55	84	
Do	do	Mar. 13, 1941	8,130	5.0	11.8	91.9	4.2	4	7.5	110	76	
Laurel Creek, above Damascus, Va	TeHoSfL 881	Feb. 28, 1941	24	.5	13.7	94.7	1.7	4	7.2	5	43	21
Do	do	Mar. 6, 1941	71	2.0	13.4	97.0	1.5	9	6.7	5	33	
Do	do	Mar. 12, 1941	55	4.0	12.7	96.9	1.4	4	6.5	5	16	
Beaver Creek, above Damascus, Va	TeHoSfLB 882	Feb. 28, 1941	36	.5	13.7	95.0	1.2	2	6.6	5	38	13
Do	do	Mar. 6, 1941	208	2.0	13.3	96.0	1.1	4	6.4	5	22	
Do	do	Mar. 12, 1941	140	4.0	12.5	95.5	1.9	4	6.2	25	10	
Beaver Creek, below Damascus, Va	TeHoSfLB 879	Feb. 28, 1941	60	.5	13.3	92.4	3.5	93	6.7	5	54	15
Do	do	Mar. 6, 1941	279	2.0	13.0	93.9	1.3	43	6.4	5	21	
Middle Fork Holston River, 2 miles east of Marion, Va.	TeHoSfMf 1020	Feb. 28, 1941	5	2.0	11.7	84.5	2.5	2	7.5	5	96	81
Do	do	Mar. 6, 1941	3	2.0	11.9	85.8	2.9	2	7.5	5	76	
Do	do	Mar. 12, 1941	131	3.0	12.4	92.1	2.0	24	7.3	38	41	
Middle Fork, Holston River, west corporate limits, Marion, Va.	TeHoSfMf 1017	Feb. 28, 1941	33	2.0	11.9	85.7	5.1	930	7.5	5	117	84
Do	do	Mar. 6, 1941	40	3.0	11.3	83.7	5.6	430	7.5	10	99	
Do	do	Mar. 12, 1941	131	3.0	12.4	91.7	2.6	430	7.2	49	45	

Wolf Creek sewage disposal plant, Abingdon, Va.	TeHoSfW 863	Feb. 28, 1941	15	4.0	11.3	86.4	8.2	43	7.6	10	202	139
Do	do	Mar. 6, 1941	15	6.0	11.3	90.9	6.1	21	7.7	5	197	
Do	do	Mar. 12, 1941	36	7.0	11.0	90.4	4.3	230	7.7	40	168	
South Fork, Holston River, near Bluff City, Tenn.	TeHoSf 824	Mar. 5, 1941	682	5.0	12.9	101.1	.5	4	7.6	5	99	65
Do	do	Mar. 11, 1941	3,460	6.0	11.3	90.4	3.1	23	7.4	200	70	
Beaver Creek, above paper plant, above Bristol, Va.	TeHoSfBe 834	Mar. 3, 1941	11	7.5	12.3	102.7	1.5	2	8.1	5	212	154
Do	do	Mar. 7, 1941	45	6.0	11.5	91.8	4.0	93	7.8	360	191	
Do	do	Mar. 13, 1941	40	6.5	11.5	93.0	8.4	8	7.9	46	189	
Beaver Creek city limits, below Bristol, Tenn.	TeHoSfBe 832	Mar. 3, 1941	17	13.0	5.0	47.2	137	15,000	8.5	310	290	184
Do	do	Mar. 7, 1941	69	7.0	6.2	51.1	55.6	4,300	9.0	900	159	
Do	do	Mar. 13, 1941	63	8.0	8.4	70.9	56.8	4,300	8.1	111	203	
Watauga River, above Elizabethton, Tenn.	TeHoSfWt 842	Feb. 27, 1941	883	5.0	12.3	96.2	3.0	2	7.5	5	54	34
Do	do	Mar. 5, 1941	1,190	5.0	12.7	99.4	2.8	2	7.4	10	51	
Do	do	Mar. 11, 1941	2,120	6.0	11.4	91.7	4.2	9	7.2	65	31	
Watauga River, 1 mile below rayon plant, Elizabethton, Tenn.	TeHoSfWt 840	Feb. 27, 1941	883	7.0	10.6	86.9	12.0	210	8.6	32	81	45
Do	do	Mar. 5, 1941	1,190	5.0	11.5	89.8	10.5	430	8.2	32	62	
Do	do	Mar. 11, 1941	2,120	7.0	10.6	86.8	7.1	430	7.2	94	37	
Holston River, near Rogersville, Tenn.	TeHo	Mar. 5, 1941	1,790	1.5	11.1	78.8	3.1	(1)	7.5	5	111	162
Do	do	Mar. 11, 1941	10,200	5.5	10.4	82.6	6.1	21	7.4	170	84	
Croquette Creek, below Rogersville, Tenn.	TeHoCr	Feb. 27, 1941	1	5.0	8.9	69.7	4.7	4,600	7.7	5	215	150
Do	do	Mar. 5, 1941	1	1.5	11.4	81.0	7.0	2,400	7.6	5	227	
Do	do	Mar. 11, 1941	5	7.0	10.2	84.1	3.9	930	7.6	230	135	
Turkey Creek, above Morristown, Tenn.	TeHoT 732	Feb. 13, 1941	1	7.0	11.6	95.6	2.0	9	7.9	5	233	187
Do	do	Feb. 17, 1941	(1)	7.0	11.5	94.5	1.0	1	7.9	5	225	
Do	do	Feb. 19, 1941	2	2.5	12.8	93.6	1.8	1	7.9	5	230	
Turkey Creek, below Morristown, Tenn.	TeHoT 730	Feb. 13, 1941	2	8.0	7.9	66.6	5.5	91	7.6	10	232	192
Do	do	Feb. 17, 1941	2	7.0	8.8	72.6	2.6	430	7.7	5	211	
Do	do	Feb. 19, 1941	3	8.0	10.0	84.4	3.0	230	7.6	5	222	
Mossy Creek, above Jefferson City, Tenn.	TeHoM 702	Feb. 13, 1941	9	12.0	9.0	83.1	1.9	2	7.7	5	239	176
Do	do	Feb. 17, 1941	13	12.0	9.6	88.3	1.0	1	7.6	5	233	
Do	do	Feb. 19, 1941	13	11.0	9.9	89.0	1.1	2	7.7	10	230	
Mossy Creek, below Jefferson City, Tenn.	TeHoM 700	Feb. 13, 1941	24	9.0	10.3	89.0	1.4	73	7.8	10	236	176
Do	do	Feb. 17, 1941	20	10.0	10.8	95.3	2.4	750	8.0	30	235	
Do	do	Feb. 19, 1941	16	7.5	11.6	96.8	1.8	930	8.0	10	235	
French Broad River, ½ mile above Rosman, N. C.	TeF 860	Feb. 24, 1941	111	0	13.3	91.0	.5	4	6.9	8	21	12
Do	do	Feb. 27, 1941	126	4.0	12.1	92.0	1.1	1	6.9	8	10	
Do	do	Mar. 4, 1941	154	8.5	10.9	93.1	1.1	1	6.9	7	6	

[1] Less than 1.

TABLE T-7.—*Tennessee River Basin: Ohio River pollution survey laboratory data*—Continued

SUMMARRY OF INDIVIDUAL RESULTS—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen: Parts per million	Dissolved oxygen: Percent of saturation	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
French Broad River, below Rosman, N. C.	TeF 858	Feb. 24, 1941	111	0	12.8	87.4	3.1	91	6.9	15	16	14
Do	do	Feb. 27, 1941	126	4.0	11.4	87.2	4.2	93	6.9	15	13	----------
Do	do	Mar. 4, 1941	154	8.5	10.3	88.2	3.7	43	6.9	15	13	----------
French Broad River, at Brevard, N. C.	TeF 841	Feb. 24, 1941	307	.5	11.7	80.8	1.0	43	6.9	20	18	11
Do	do	Feb. 27, 1941	280	3.5	11.1	83.4	.8	43	6.9	10	13	----------
Do	do	Mar. 4, 1941	353	9.5	9.8	85.1	1.4	43	6.9	9	11	----------
Davidson River, near Brevard, N. C.	TeFD 838	Feb. 24, 1941	54	.5	10.8	74.8	[2] 38.8 5.5	43	8.9	110	44	39
Do	do	Feb. 27, 1941	66	4.0	9.4	71.4	35.7 22.0	43	8.9	220	40	----------
Do	do	Mar. 4, 1941	201	9.5	9.9	86.7	20.4	23	6.9	500	21	----------
Mud Creek, ½ mile above Hendersonville, N. C.	TeFM 830	Feb. 24, 1941	34	2.0	12.3	89.0	.9	4	7.0	25	15	10
Do	do	Feb. 27, 1941	27	5.0	11.6	90.8	2.0	46	6.9	12	2	----------
Do	do	Mar. 4, 1941	36	9.5	10.8	94.3	1.2	110	6.9	25	12	----------
Mud Creek, ¼ mile below Hendersonville, N. C.	TeFM 829	Feb. 24, 1941	70	2.0	12.0	86.7	2.9	4,600	6.9	20	20	12
Do	do	Feb. 27, 1941	68	5.0	11.8	92.0	2.4	36	----------	----------	----------	----------
Do	do	Mar. 4, 1941	75	10.5	9.9	88.1	4.8	2,400	6.9	25	14	----------
Mud Creek, 2 miles below Hendersonville, N. C.	TeFM 828	Feb. 24, 1941	112	2.0	12.6	91.0	1.1	2,400	6.9	20	16	15
Do	do	Feb. 27, 1941	112	5.0	11.1	87.0	2.5	230	7.0	15	13	----------
Do	do	Mar. 4, 1941	154	10.5	10.1	90.3	1.9	43	6.9	65	15	----------
French Broad River, above Hominy Creek, above Asheville.	Te F	Mar. 6, 1941	903	1.0	11.0	77.2	1.8	24	6.9	15	14	----------
Hominy Creek, outfall rayon plant, Enka, N. C.	TeFH	Feb. 25, 1941	62	5.5	9.7	76.8	[2] 42.1 16.6	4	9.6	25	158	15
Do	do	Feb. 28, 1941	28	1.0	10.8	76.2	27.0	110	6.9	30	20	----------
Do	do	Mar. 5, 1941	33	2.5	10.3	75.5	16.9	460	6.6	25	16	----------
Hominy Creek, at mouth	TeFH	Mar. 6, 1941	40	2.5	8.3	60.9	[2] 35.5 13.1	240	3.7	30	----------	----------
French Broad River, 1 mile above Asheville, N. C.	TeF	Feb. 26, 1941	892	2.5	10.6	77.6	5.8	46	6.8	10	2	19
Do	do	Mar. 3, 1941	810	3.5	10.8	80.8	4.1	46	6.3	10	8	----------
Do	do	Mar. 6, 1941	905	2.5	10.2	74.7	5.2	240	6.2	20	15	----------

French Broad River, below industrial plants, Asheville.	TeF	Feb. 26, 1941	1,000	3.5	11.1	83.4	2.4	75	7.0	12	13	12
Do	do	Mar. 3, 1941	952	4.0	11.4	86.9	1.4	93	6.9	8	15	----------
Do	do	Mar. 6, 1941	1,100	2.5	10.9	80.0	1.8	460	6.9	25	18	----------
French Broad River, ¼ mile below Asheville, N. C.	TeF	Feb. 26, 1941	1,000	3.5	11.1	83.2	3.4	210	7.0	10	17	14
Do	do	Mar. 3, 1941	952	4.5	11.4	88.3	2.8	1,500	6.9	8	12	----------
Do	do	Mar. 6, 1941	1,100	.5	10.6	73.8	2.3	230	6.9	30	19	----------
French Broad River, 4 miles below Asheville, N. C.	TeF	Feb. 26, 1941	1,000	3.5	11.1	83.2	2.7	140	7.0	10	16	14
Do	do	Mar. 3, 1941	952	5.5	11.2	88.8	2.2	75	6.9	10	12	----------
Do	do	Mar. 6, 1941	1,100	.5	10.3	71.6	3.3	1,100	6.8	25	20	----------
Pigeon River, ¼ mile above Canton, N. C.	TeFP 791	Feb. 25, 1941	126	3.0	12.4	92.0	1.1	9	7.3	4	8	11
Do	do	Feb. 28, 1941	110	0	12.7	86.8	1.5	9	6.9	10	12	----------
Do	do	Mar. 5, 1941	149	.5	12.1	84.1	1.2	24	6.9	8	10	----------
Pigeon River, ½ mile below fiber plant, Canton, N. C.	TeFP 789	Feb. 25, 1941	126	7.0	0	0	[2] 289 136	1,100	8.5	250	138	229
Do	do	Feb. 28, 1941	110	1.5	0	0	313	1,100	7.2	320	215	----------
Do	do	Mar. 5, 1941	149	4.5	2.7	20.7	264	930	7.3	150	96	----------
Pigeon River, Clyde, N. C., 4 miles below Canton, N. C.	TeFP 784	Feb. 25, 1941	126	3.5	0	0	[2] 291 138	460	8.9	160	199	148
Do	do	Feb. 28, 1941	110	1.0	0	0	286	2,400	7.1	280	162	----------
Do	do	Mar. 5, 1941	149	1.5	0	0	[2] 230 200	930	8.8	120	96	----------
Richland Creek, near mouth, Waynesville, N. C.	TeFPR 771	Feb. 25, 1941	55	3.5	11.8	89.0	2.4	36	6.9	5	13	17
Do	do	Feb. 28, 1941	58	.5	12.0	83.5	1.5	9	6.9	15	14	----------
Do	do	Mar. 5, 1941	80	0	12.0	82.2	.8	3	6.9	10	13	----------
Indian Creek, above Erwin, Tenn.	TeFNI	Feb. 27, 1941	10	5.0	12.5	98.0	2.3	9	6.9	5	39	29
Do	do	Mar. 5, 1941	37	3.0	13.3	98.7	2.1	24	6.7	5	36	----------
Do	do	Mar. 11, 1941	286	5.0	11.7	91.6	2.0	43	6.6	105	27	----------
Indian Creek, at Clinchfield railroad shops, Erwin, Tenn.	TeFNI	Feb. 27, 1941	17	6.0	11.5	92.5	11.4	1,500	7.1	300	47	30
Do	do	Mar. 5, 1941	53	3.0	12.6	93.2	8.1	1,600	6.7	460	37	----------
Do	do	Mar. 11, 1941	286	5.0	11.5	90.0	4.9	430	6.7	160	24	----------
West Fork Little Pigeon River, above Gatlinburg, Tenn.	TeFLpWf	Feb. 13, 1941	27	4.0	12.3	94.0	1.4	1	6.4	5	13	7
West Fork Little Pigeon River, below Gatlinburg, Tenn.	TeFLpWf	Feb. 13, 1941	45	4.0	12.6	95.8	1.3	150	6.5	5	11	7
Pistol Creek, corporate limit above Maryville, Tenn.	TeLP 651	Feb. 17, 1941	3	10.0	11.3	99.7	1.2	24	7.9	10	153	----------
Do	do	Feb. 19, 1941	3	7.5	12.1	100.3	.5	4	7.9	5	155	----------
Pistol Creek, above Maryville, Tenn.	TeLP 650	Feb. 14, 1941	3	9.0	10.3	88.5	4.8	1,100	7.7	37	160	93
Pistol Creek, below sewage plant, Alcoa, Tenn.	TeLP 647	Feb. 14, 1941	30	8.0	6.1	51.4	10.6	930	7.4	32	143	103
Do	do	Feb. 17, 1941	33	9.0	8.6	74.4	3.5	2,400	7.5	10	156	----------
Do	do	Feb. 19, 1941	21	6.5	8.5	69.0	5.8	930	7.5	10	161	----------

[2] Seeded and neutralized.

TABLE T-7.—*Tennessee River Basin: Ohio River pollution survey, laboratory data*—Continued

SUMMARY OF INDIVIDUAL RESULTS—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Town Creek, above Lenoir City, Tenn.	TeT	Feb. 14, 1941	5	9.0	8.7	75.4	4.1	23	7.8	20	144	114
Do	do	Feb. 18, 1941	5	7.5	12.3	102.0	1.1	24	7.9	5	134	
Do	do	Feb. 20, 1941	5	6.5	12.7	103.1	1.4	2	7.9	5	143	
Town Creek, below Lenoir City, Tenn.	TeT	Feb. 14, 1941	6	9.0	7.7	66.6	11.4	9,300	7.5	27	140	111
Do	do	Feb. 18, 1941	7	9.0	6.2	53.5	22.5	12,000	7.4	45	145	
Do	do	Feb. 20, 1941	7	7.0	7.8	64.1	17.0	9,300	7.4	25	146	
Tennessee River, below Louden, Tenn.	Te 591	Feb. 14, 1941	9,080	5.0	11.1	86.8	4.5	9	7.3	15	52	52
Do	do	Feb. 18, 1941	9,080	5.0	10.9	85.2	3.2	7	7.2	10	50	
Do	do	Feb. 20, 1941	9,080	5.0	11.0	85.7	2.9	16	7.2	10	70	
Guest River, above Norton, Va.	TeClG 834	Feb. 26, 1941	6	1.0	12.9	90.5	1.9	2	6.6	5	23	26
Do	do	Mar. 4, 1941	47	3.0	11.7	86.5	2.7	46	6.5	148	22	
Do	do	Mar. 10, 1941	83	3.0	12.1	89.5	2.1	24	6.2	15	13	
Guest River, below Norton, Va.	TeClG 832	Feb. 26, 1941	9	2.0	9.9	71.2	19.6	24,000	6.7	10	42	60
Do	do	Mar. 4, 1941	51	3.0	11.2	83.4	9.5	3,900	6.5	131	27	
Do	do	Mar. 10, 1941	88	3.0	11.7	86.8	3.9	2,400	6.2	15	19	
Gladly Creek, corporate limit, above Wise, Va.	TeClGGl	Feb. 26, 1941	(1)	.5	11.4	79.2	2.4	1	6.3	5	20	19
Do	do	Mar. 4, 1941	3	1.0	12.0	84.3	4.3	36	6.0	280	14	
Do	do	Mar. 10, 1941	4	1.0	12.2	85.9	1.5	1	6.1	25	15	
Gladly Creek, rear of school, below Wise, Va.	TeClGGl	Feb. 26, 1941	1	2.0	10.1	72.7	24.7	4,600	7.1	15	43	34
Do	do	Mar. 4, 1941	20	2.5	12.2	89.2	7.6	240	6.2	170	17	
Do	do	Mar. 10, 1941	14	1.5	12.6	89.5	6.3	430	6.5	32	19	
North Fork, Powell River, above Big Stone Gap, Va.	TeClPNf 817	Feb. 26, 1941	38	5.0	13.6	106.2	3.5	240	7.5	5	115	64
Do	do	Mar. 4, 1941	132	5.0	11.7	91.2	6.4	460	7.1	108	78	
Do	do	Mar. 10, 1941	165	3.5	12.8	96.2	1.8	93	6.7	5	36	
Do	do	Feb. 26, 1941	17	3.0	13.7	101.6	3.0	240	7.0	5	63	47
Do	do	Mar. 4, 1941	77	6.0	11.6	93.1	2.3	1,100	6.9	20	63	
Do	do	Mar. 10, 1941	110	5.5	12.3	97.6	1.7	240	6.7	10	36	
Powell River, below Big Stone Gap, Va.	TeClP 815	Feb. 26, 1941	54	2.0	14.9	107.5	3.0	460	8.0	5	93	60
Do	do	Mar. 4, 1941	244	5.0	10.9	85.2	4.2	230	7.4	80	93	
Do	do	Mar. 10, 1941	319	4.5	12.6	97.3	1.6	150	6.7	10	36	

King Creek, 1 mile above Pennington Gap, Va.	TeClPK	Mar. 3, 1941	2	7.0	10.1	82.7	1.5	15	7.5	5	148	108
Do	do	Mar. 7, 1941	21	8.0	10.3	87.1	5.5	240	7.5	650	127	
Do	do	Mar. 13, 1941	15	8.0	10.6	89.6	.9	24	7.5	15	104	
King Creek, below Pennington Gap, Va.	TecClPK	Mar. 3, 1941	2	7.0	9.0	73.6	3.2	930	7.4	5	168	125
Do	do	Mar. 7, 1941	26	8.0	8.0	67.7	24.5	2,400	7.4	850	137	
Do	do	Mar. 13, 1941	20	7.5	10.3	85.5	1.5	1,200	7.5	10	116	
Powell River, west of Dot, Va	TeClP	Mar. 3, 1941	80	6.0	13.0	104.2	2.1	4	7.7	5	100	63
Do	do	Mar. 7, 1941	390	7.0	11.9	97.9	1.7	9	7.4	20	57	
Do	do	Mar. 13, 1941	1,300	7.0	11.4	94.0	1.2	24	7.3	15	40	
Hines Creek, below Rockwood, Tenn.	TeKHi 557	Feb. 14, 1941	1	9.0	4.8	41.1	14.6	2,400	7.4	25	217	155
Do	do	Feb. 18, 1941	2	8.0	4.8	40.4	23.7	9,300	7.4	15	229	
Do	do	Feb. 20, 1941	1	6.0	5.9	47.0	17.8	2,300	7.4	15	214	
Hiwassee River above mouth Ocoee River, south of Wetmore, Tenn.	TeH 536	Feb. 4, 1941	1,060	3.0	12.6	93.5	.3	4	6.9	25	13	16
Do	do	Feb. 10, 1941	168	1.5	12.9	92.2	.2	(1)	6.9	7	17	
Do	do	Feb. 13, 1941	1,650	7.0	12.0	98.4	1.0	(1)	7.0	10	15	
Cane Creek, below Etowah, Tenn.	TeHC	Feb. 4, 1941	1	2.5	10.9	80.0	6.5	24,000	7.3	35	243	191
Do	do	Feb. 10, 1941	1	2.0	9.6	69.6	49.4	15,000	7.3	35	267	
Do	do	Feb. 13, 1941	(1)	7.5	7.0	58.1	57.5	24,000	7.3	75	268	
Ocoee River, above Copper Hill, Tenn.	TeHO 570	Feb. 3, 1941	177	4.5	11.7	90.4	.4	2	6.1	2	14	14
Do	do	Feb. 7, 1941	173	4.5	11.6	89.4	.4	1	6.9	10	18	
Do	do	Feb. 12, 1941	157	1.0	13.1	92.1	1.0	(1)	6.9	3	11	
Ocoee River, below Copper Hill, Tenn.	TeHO 568	Feb. 3, 1941	177	6.5	8.3	67.2	[2] 4.7 15.6	(1)	3.4	110		271
Do	do	Feb. 7, 1941	173	6.5	5.1	41.3	[2] 5.6 11.4	(1)	5.5	400		
Do	do	Feb. 12, 1941	157	2.0	5.7	41.2	[2] 7.8 4.3	(1)	3.3	70		
Potato Creek, below copper plant, near Ducktown, Tenn.	TeHOP	Feb. 3, 1941	8	6.0	1.8	14.7	[2] 67.4 59.7	4	5.5	130		1,249
Do	do	Feb. 7, 1941	7	6.0	0	0	[2] 95.5 23.6	4	5.5	45		
Do	do	Feb. 12, 1941	8	3.5	12.0	90.2	[2] 86.2 23.6	(1)	3.7	175		
Ocoee River, Emf, Tenn.	TeHO	Feb. 3, 1941	225	4.5	10.8	83.4	[2] .8 1.4	4	6.0	15		109
Do	do	Feb. 7, 1941	224	4.5	10.6	81.3	[2] 1.9 2.1	(1)	3.7	4		
Do	do	Feb. 12, 1941	204	2.0	6.6	47.3	[2] 1.2 1.2	(1)	5.7	8		
Ocoee River, at mouth	TeHO 535	Feb. 4, 1941	175	3.0	11.6	86.0	.3	4	6.7	5	8	54
Do	do	Feb. 10, 1941	1,420	3.0	11.9	88.4	.8	(1)	6.7	6	10	
Do	do	Feb. 13, 1941	211	7.5	11.2	92.8	.6	(1)	6.9	8	9	
Oostanaula River, ¼ mile above Athens, Tenn.	TeHOs 549	Feb. 4, 1941	16	3.5	10.3	77.7	.7	9	7.5	8	133	131
Do	do	Feb. 10, 1941	15	2.0	10.6	76.2	.5	240	7.3	3	134	
Do	do	Feb. 13, 1941	15	8.5	9.6	81.9	.6	75	7.5	8	133	

[1] Less than 1.
[2] Seeded and neutralized.

TABLE T-7.—*Tennessee River Basin: Ohio River pollution survey, laboratory data*—Continued

SUMMARY OF INDIVIDUAL RESULTS—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Oostanaula River, ¼ mile below Athens, Tenn.	TeHOs 547	Feb. 4, 1941	16	3.5	8.4	63.4	7.8	4,600	7.5	15	138	122
Do	do	Feb. 10, 1941	15	2.0	9.0	65.2	6.9	910	7.3	15	139	
Do	do	Feb. 13, 1941	15	9.0	7.6	65.4	3.4	2,400	7.4	12	138	
Hiwassee River, Charleston, Tenn.	TeH 515	Feb. 4, 1941	1,235	2.0	11.4	82.1	.4	1	7.4	10	51	68
Do	do	Feb. 10, 1941	1,588	1.0	12.4	87.3	.4	4	7.0	4	34	
Do	do	Feb. 13, 1941	1,861	6.0	11.9	95.3	1.2	(1)	7.0	20	26	
South Mouse Creek, below Woolen Mills, Cleveland, Tenn.	TeHSm 532	Feb. 3, 1941	1	9.5	7.9	69.1	82.8	75	8.2	70	138	154
Do	do	Feb. 7, 1941	1	7.5	4.1	33.8	36.9	1,100	7.0	170	117	
Do	do	Feb. 12, 1914	1	10.5	7.2	64.2	84.1	230	8.7	210	158	
South Mouse Creek, below sewage plant, Cleveland, Tenn.	TeHSm 530	Feb. 3, 1941	10	7.5	8.3	69.4	14.9	11,000	7.5	10	163	135
Do	do	Feb. 7, 1941	8	6.5	7.1	57.4	13.0	7,500	7.3	15	167	
Do	do	Feb. 12, 1941	7	7.0	7.8	63.8	19.2	9,300	7.3	20	170	
Town Branch, below sewage plant, Cleveland, Tenn.	TeHSmT 530	Feb. 3, 1941	1	6.5	9.2	74.9	14.0	24,000	7.5	7	181	155
Do	do	Feb. 7, 1941	1	6.5	8.7	70.9	14.6	9,300	7.4	7	177	
Do	do	Feb. 12, 1941	1	6.0	8.1	65.0	12.8	240,000	7.5	7	180	
South Mouse Creek, below junction of town branch, Cleveland, Tenn.	TeHSm 527	Feb. 3, 1941	11	6.5	9.2	75.0	3.2	750	7.5	8	143	127
Do	do	Feb. 7, 1941	9	7.0	4.6	37.5	27.7	2,400	7.4	15	181	
Do	do	Feb. 12, 1941	8	7.0	7.8	63.8	5.4	930	7.3	10	165	
Spring Creek, ¼ mile above sewage plant, Fort Oglethorpe, Ga.	TeChSp	Feb. 6, 1941	1	3.0	11.5	85.6	1.6	150	7.4	5	152	148
Do	do	Feb. 14, 1941	1	6.5	9.3	75.2	4.0	23	7.3	45	146	
Do	do	Feb. 18, 1941	1	3.0	11.8	87.2	2.0	43	7.6	8	175	
Spring Creek, 100 yards below sewage plant, Fort Oglethorpe.	TeChSp	Feb. 6, 1941	1	3.5	9.2	69.5	25.8	24,000	7.4	15	144	143
Do	do	Feb. 14, 1941	1	6.5	9.4	76.3	5.8	360	7.3	50	148	
Do	do	Feb. 18, 1941	1	4.0	11.9	90.9	5.6	36	7.5	5	181	
Chickamauga Creek, mouth, Chattanooga, Tenn.	TeCk 473	Feb. 6, 1941	257	5.0	11.3	88.3	.8	9	7.6	7	110	108
Do	do	Feb. 14, 1941	222	6.0	10.8	86.8	1.7	39	7.5	20	117	
Do	do	Feb. 18, 1941	193	6.5	11.4	92.8	1.2	4	7.5	10	121	

Chattanooga Creek, mouth, Chattanooga, Tenn.	TeCh 460	Feb. 6, 1941	40	5.5	2.[illegible]	20.[illegible]	[2] 274 80.4	240	9.6	45	171	95
Do	do	Feb. 14, 1941	70	7.5	.3	2.7	[2] 158 99.4	2,400	8.9	140	163	----------
Do	do	Feb. 18, 1941	24	6.5	.3	2.7	[2] 201 98.6	4,600	9.6	250	196	----------
Big Sequatchie River, mouth, Jasper, Tenn.	TeS	Feb. 5, 1941	585	7.0	11.1	91.1	.6	4	7.2	8	64	65
Do	do	Feb. 11, 1941	389	6.0	11.7	94.1	.8	(1)	7.3	9	72	----------
Do	do	Feb. 17, 1941	319	7.5	11.4	94.4	.5	1	7.3	8	75	----------
Tennessee River, ferry, South Pittsburg, Tenn.	Te	Feb. 5, 1941	14,300	6.0	10.7	85.6	1.8	17	7.0	6	47	59
Do	do	Feb. 11, 1941	13,600	6.0	10.6	84.9	1.7	12	7.1	16	50	----------
Do	do	Feb. 17, 1941	11,500	7.5	11.0	91.2	1.5	20	7.1	15	51	----------
Tennessee River, ferry, Bridgeport, Ala.	Te 414	Feb. 5, 1941	14,300	6.5	10.7	87.0	1.4	18	7.2	8	48	61
Do	do	Feb. 11, 1941	13,600	4.5	10.6	81.8	2.6	17	7.1	18	49	----------
Do	do	Feb. 17, 1941	11,500	8.0	10.9	92.2	2.2	24	7.1	16	53	----------
Roseberry Creek, 2 miles below Scottsboro, Ala.	TeR 383	Feb. 5, 1941	8	5.0	8.9	69.6	3.0	4,600	7.4	5	132	125
Do	do	Feb. 11, 1941	5	2.0	7.8	56.2	5.9	910	7.3	12	144	----------
Do	do	Feb. 17, 1941	9	8.0	8.6	72.4	4.5	430	7.3	20	145	----------
Spring Creek, waterworks, above Huntsville, Ala.	TeSp	Jan. 23, 1941	34	16.0	9.5	95.4	.5	2	7.3	2	122	122
Do	do	Jan. 27, 1941	67	13.0	9.1	85.8	1.0	4	7.3	2	126	----------
Do	do	Jan. 29, 1941	48	11.0	9.0	81.0	1.2	2	7.3	3	126	----------
Spring Creek, below sewer, below Huntsville, Ala.	TeSp	Jan. 23, 1941	37	15.5	7.6	75.3	6.4	24,000	7.4	15	131	124
Do	do	Jan. 27, 1941	73	7.5	10.6	88.2	2.4	360	7.4	25	93	----------
Do	do	Jan. 29, 1941	52	5.0	10.9	85.1	2.0	72	7.5	5	101	----------
Spring Creek, 3 miles below Huntsville, Ala.	TeSp	Jan. 23, 1941	37	12.5	6.5	61.0	3.1	430	7.2	4	110	112
Do	do	Jan. 27, 1941	73	7.5	8.9	74.4	1.8	430	7.5	20	115	----------
Do	do	Jan. 29, 1941	52	5.5	9.1	72.1	1.7	230	7.5	9	113	----------
Swan Creek, above Athens, Ala.	TeSw 316	Jan. 23, 1941	38	11.0	10.9	98.4	.5	8	6.9	7	26	26
Do	do	Jan. 27, 1941	145	7.0	11.2	91.9	.9	46	6.9	20	23	----------
Do	do	Jan. 29, 1941	56	4.0	12.1	92.2	.8	24	6.8	5	11	----------
Swan Creek, below sewer, Athens, Ala.	TeSw 311	Jan. 23, 1941	44	14.0	6.8	65.5	7.3	2,400	6.8	15	58	42
Do	do	Jan. 27, 1941	163	7.0	10.2	83.4	.9	36	6.1	20	12	----------
Do	do	Jan. 29, 1941	66	4.5	12.0	92.1	.8	15	6.9	10	19	----------
Rock Creek, above Tullahoma, Tenn.	TeElRc 459	Feb. 3, 1941	4	5.5	10.5	82.9	4.9	4	6.7	5	31	27
Do	do	Feb. 5, 1941	3	4.5	11.2	86.4	2.3	2	6.7	5	48	----------
Do	do	Feb. 7, 1941	4	5.0	10.4	81.4	2.1	1	6.9	5	46	----------
Rock Creek, below Tullahoma, Tenn.	TeElRc 457	Feb. 3, 1941	6	5.5	7.0	55.1	49.2	7,500	6.7	20	56	31
Do	do	Feb. 5, 1941	4	4.5	8.0	61.3	24.6	4,300	6.9	25	72	----------
Do	do	Feb. 7, 1941	4	5.0	5.8	45.5	28.8	9,300	6.9	31	73	----------

[1] Less than 1.
[2] Seeded and neutralized.

TABLE T-7.—*Tennessee River Basin: Ohio River pollution survey, laboratory data*—Continued

SUMMARY OF INDIVIDUAL RESULTS—Continued

Sampling point	Mileage from mouth	Date	Average discharge, cubic feet per second	Temperature ° C.	Dissolved oxygen		5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
					Parts per million	Percent of saturation						
Pigeon Roos Creek, below phosphate plant, above Pulaski, Tenn.	TeElRP	Jan. 23, 1941	11	12.0	11.2	103.8	1.4	4	6.8	150	72	117
Do	do	Jan. 27, 1941	71	8.0	11.2	94.6	.7	9	6.9	30	58	
Do	do	Jan. 29, 1941	34	5.5	11.6	91.6	1.8	2	6.9	90	53	
Richland Creek, above Pulaski, Tenn.	TeElR 352	Jan. 22, 1941	132	9.5	11.9	104.0	.8	2	7.7	10	120	138
Do	do	Jan. 24, 1941	470	11.0	10.1	92.4	3.2	110	7.4	550	95	
Do	do	Jan. 28, 1941	900	6.0	11.1	88.8	2.3	15	7.5	25	96	
Richland Creek, below Pulaski, Tenn.	TeElR 351	Jan. 22, 1941	132	10.0	11.3	99.4	4.2	460	7.6	20	119	122
Do	do	Jan. 24, 1941	470	11.5	10.0	91.2	5.9	460	7.4	250	102	
Do	do	Jan. 28, 1941	900	5.0	11.2	87.6	1.3	91	7.5	25	95	
Shoal Creek, above Lawrenceburg, Tenn.	TeSh 324	Jan. 22, 1941	38	13.0	10.8	102.4	.5	15	7.4	4	79	91
Do	do	Jan. 24, 1941	60	13.0	9.8	92.9	1.8	46	6.8	1,200	60	
Do	do	Jan. 28, 1941	51	7.5	10.6	87.8	.9	9	7.3	5	55	
Shoal Creek, below Lawrenceburg, Tenn.	TeSh 322	Jan. 22, 1941	38	11.0	10.8	97.1	9.3	2,400	7.4	10	88	69
Do	do	Jan. 24, 1941	60	12.0	8.9	82.3	5.4	2,400	6.8	500	57	
Do	do	Jan. 28, 1941	51	4.5	10.9	83.7	5.1	4,600	7.2	8	55	
Shoal Creek, bridge, Iron City, Tenn.	TeSh 275	Jan. 22, 1941	212	8.5	12.0	102.6	.8	4	7.4	3	60	56
Do	do	Jan. 24, 1941	355	10.5	10.5	93.5	.8	9	7.0	120	52	
Do	do	Jan. 28, 1941	990	5.5	11.5	91.1	.7	4	7.0	10	39	
Mud Creek, below Russellville, Ala.	TeBM 293	Jan. 22, 1941		16.0	7.6	76.1	15.0	11,000	7.4	3	148	123
Do	do	Jan. 24, 1941		17.0	8.2	84.6	6.1	3,900	7.0	350	76	
Rock Creek, above Lewisburg, Tenn.	TeDRc 310	Jan. 28, 1941	46	4.5	11.4	88.0	1.1	9	7.5	8	138	
Do	TeDRc 309	Jan. 22, 1941	5	9.0	11.6	100.1	.9	46	8.3	4	160	162
Do	do	Jan. 24, 1941	146	11.5	8.8	80.7	2.0	1,100	7.5	300	116	
Rock Creek, below Lewisburg, Tenn.	TeDRc 307	Jan. 22, 1941	5	10.5	10.7	95.1	1.5	93	7.9	2	181	164
Do	do	Jan. 24, 1941	146	12.0	8.6	79.7	6.2	1,100	7.4	1,200	116	
Do	do	Jan. 28, 1941	46	3.0	11.4	84.4	1.0	36	7.6	5	152	
Piney Creek, 1½ miles below Dickson, Tenn.	TeDP	Jan. 23, 1941	3	9.0	10.1	86.8	2.5	75	7.5	5	128	91
Do	do	Jan. 27, 1941	13	7.0	10.7	87.6	2.5	230	7.4	10	82	
Do	do	Jan. 29, 1941	9	6.0	10.9	87.0	1.9	230	7.4	5	96	
Do	do	Jan. 31, 1941	8	8.0	10.7	90.5	5.7	39	7.4	10	102	

Tennessee River, Norton's Bluff Bridge.	Te 5.3	Sept. 21, 1940	22,600	25.5	8.2	99.0	.9	2	7.7	10	57	72
Do	do	Sept. 25, 1940	25,800	22.0	8.0	90.1	.8	(1)	7.7	10	59	
Do	do	Sept. 26, 1940	30,600	21.0	8.3	92.1	.8	2	7.7	10	58	
Do	do	Oct. 1, 1940	26,300	20.5	8.4	92.6	.7	(1)	7.7	10	61	
Do	do	Nov. 14, 1940	32,100	10.5	9.7	86.2	.7	4	7.1	25	51	
Do	do	Nov. 15, 1940	31,600	8.5	10.3	87.8	.7	2	7.3	35	52	54
Do	do	Nov. 16, 1940	30,500	7.5	10.4	86.8	.8	9	7.1	43	50	
Do	do	Nov. 18, 1940	30,000	9.0	10.3	89.0	.6	2	7.1	43	50	
Do	do	Mar. 1, 1941	23,700	5.5	13.5	107.0	2.0	1	7.7	32	66	
Do	do	Mar. 4, 1941	23,200	7.0	13.0	106.6	1.5	(1)	7.6	35	64	86
Do	do	Mar. 5, 1941	25,600	7.0	12.8	105.4	1.4	1	7.7	40	64	

[1] Less than 1.

TABLE T-7-A.—*Tennessee River Basin: Ohio River pollution survey laboratory data*

SUMMARY OF AVERAGES

[By Tennessee Valley Authority]

Sampling point	Mileage from mouth	Period, 1937-38	Number of samples	Average discharge, cubic feet per second	Temperature, ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
North Fork, Holston River, mouth, near Kingsport, Tenn.	TeHoNf 794.5	May to October 1937.		800	22.6	8.4	1.2	190	7.8		77	378
Do	do	November 1937 to April 1938.		1,010	8.8	11.2	.9	20	7.8		87	303
South Fork, Holston River, above Beaver Creek.	TeHoSf 725	May to October 1937.		1,210	21.2	8.2	1.0	230	7.8		85	91
Do	do	November 1937 to April 1938.		1,240	9.8	11.3	.7	13	7.8		84	91
Beaver Creek, mouth, near Bristol, Tenn.	TeHoSfB 825	May to October 1937.		180	20.8	7.4	3.7	1,500	7.8		172	185
Do	do	November 1937 to April 1938.		160	10.7	10.2	3.0	375	7.8		173	185
South Fork, Holston River, below Beaver Creek, above Watauga.	TeHoSf 820	May to October 1937.		1,420	21.5	8.2	1.3	375	7.9		97	102
Do	do	November 1937 to April 1938.		1,420	10.1	11.4	1.0	28	7.9		97	103
Watauga River, below Elizabethton, Tenn.	TeHoSfW 831	May to October 1937.		870	20.7	7.8	1.3	80	7.7		45	52
Do	do	November 1937 to April 1938.		1,120	9.3	10.7	1.2	8	7.7		40	45
Watauga River, below Johnson City, Tenn.	TeHoSfW 829	May to October 1937.		890	21.0	7.7	2.1	110	7.7		47	54
Do	do	November 1937 to April 1938.		1,130	9.4	10.7	1.4	17	7.7		43	48
South Fork, Holston River, below Watauga River.	TeHoSf 810	May to October 1937.		2,330	21.7	7.4	3.3	350	7.7		77	87
Do	do	November 1937 to April 1938.		2,610	10.0	10.9	1.2	21	7.7		76	84
South Fork, Holston River, below Kingsport, Tenn.	TeHoSf 795	May to October 1937.		2,510	22.6	6.1	5.9	475	7.5		81	98
Do	do	November 1937 to April 1938.		3,030	9.7	10.2	3.0	34	7.7		82	93
Holston River, below North Fork, Holston River.	TeHo 784	May to October 1937.		3,340	22.7	7.0	2.0	170	7.6		81	155
Do	do	November 1937 to April 1938.		4,160	9.4	10.3	1.4	27	7.7		84	138

French Broad River, above Pigeon River.	TeFB 730.5	May to October 1937.		3,650	21.3	7.5	1.1	400			16	16
Do	do	November 1937 to April 1938.		2,990	9.5	10.8	1.0	130			15	15
Pigeon River, above Newport, Tenn.	TeFBP 733	May to October 1937.		890	20.5	5.0	9.2	190	7.6		47	59
Do	do	November 1937 to April 1938.		1,330	9.3	8.9	10.0	27	7.6		35	47
Pigeon River, below Newport, Tenn.	TeFBP 732	May to October 1937.		890	20.4	4.6	5.8	650	7.3		42	52
Do	do	November 1937 to April 1938.		1,330	9.2	8.5	8.7	60	7.2		34	46
Nolichucky River, below Greenville, Tenn.	TeFBN 758	May to October 1937.		910	21.6	7.4	1.1	160	7.4		45	46
Do	do	November 1937 to April 1938.		1,420	9.4	10.6	.8	19	7.4		47	49
Little Tennessee River, below Cheoh Dam.	TeLTe 668	August 1937		4,840	23.9		.4			50	9	8
Clinch River, above Clinton, Tenn.	TeC 627	May 12, 1937		162	21.0	7.8	.8	1	7.7	15	93	95
Do	do	May 19, 1937		249	22.0	7.0	1.1	72	7.6	100	86	94
Clinch River, below Clinton, Tenn.	TeC 625	May 12, 1937		162	21.5	7.8	1.5	110	7.7	15	92	95
Do	do	May 19, 1937		253	22.0	6.7	1.3	160	7.6	40	88	96
Emory River, Oakdale, Tenn.	TeCE 590	May to October 1937.		1,190	22.1	7.8	.7	45	6.9		10	16
Do	do	November 1937 to April 1938.		1,180	9.3	11.0	.5	10	6.8		7	13
Emory River, below Harriman, Tenn.	TeCE 579	May to October 1937.		1,270	23.5	4.8	7.7	700	6.8		25	27
Do	do	November 1937 to April 1938.		1,240	10.2	9.4	3.3	85	6.8		14	19
Clinch River, mouth	TeC 569	May to October 1937.		5,220	19.2	8.0	1.4	120	7.5		73	79
Do	do	November 1937 to April 1938.		5,710	11.2	10.0	1.0	27	7.3		59	65
Chattanooga Creek, at mouth	TeCh 461	October 1937		112	16.6	1.2	30.0	6,090	8.4	36	93	
Elk River, below Estill Spring Dam.	TeEl 451	May to November 1937.		288	19.3	7.2	1.0	65	7.2	55	81	87
Rock Creek, mouth	TeElRc 442	do		48	18.8	8.0	.9	29	7.1			
Elk Creek, below Tullahoma, Tenn.	TeEl 439	do		359	19.2	7.9	.6	2,100	7.3			
Boiling Fork Creek, below Winchester, Tenn.	TeElB 435	do		89	18.1	8.4	.9	450	7.3			
Elk River, below Winchester, Tenn.	TeEl 432	do		536	19.9	8.2	.7	250	7.3			
Mulberry Creek, below Lynchburg, Tenn.	TeElM 387	do		88	20.8	7.3	1.1	2,200	7.4			
Elk River, below Lynchburg, Tenn.	TeEl 385	do		738	20.7	7.5	.9	80	7.3			
Elk River, below Fayetteville, Tenn.	TeEl 373	do		822	21.6	7.7	.9	240	7.4			
Elk River, above Pulaski, Tenn.	TeEl 334	do		941	22.3	8.1	.9	160	7.3			

TABLE T-7-A.—*Tennessee River Basin: Ohio River pollution survey laboratory data*—Continued

SUMMARY OF AVERAGES—Continued

[By Tennessee Valley Authority]

Sampling point	Mileage from mouth	Period, 1937-38	Number of samples	Average discharge, cubic feet per second	Temperature, ° C.	Dissolved oxygen, parts per million	5-day biochemical oxygen demand, parts per million	Coliforms, most probable number per milliliter	pH	Turbidity, parts per million	Alkalinity, parts per million	Hardness, parts per million
Richland Creek, near mouth, Pulaski, Tenn.	TeElR 330	do		117	22.7	7.2	1.2	130	7.4			
Elk River, below Pulaski, Tenn.	TeEl 321	do		1,082	21.9	7.3	.9	19	7.4	110	90	96
Duck Creek, above Manchester, Tenn.[1]	TeD 380	February to November 1938.		48	17.7	8.9	.7	5	7.2	10	47	
Duck River, below Manchester, Tenn.[1]	TeD 375	do		93	17.8	8.6	.7	13	7.4	13	50	
Duck River, above Shelbyville, Tenn.[1]	TeD 336	do		372	18.7	8.2	1.0	34	7.5	45	80	82
Duck River, below Shelbyville, Tenn.[1]	TeD 317	March to November 1938.		429	19.2	8.1	1.0	155	7.5	55	86	
Duck River, above Rock Creek[1]	TeD 297	do		378	19.8	8.2	.9	26	7.5	60	95	
Big Rock Creek, mouth, near Lewisburg, Tenn.	TeDBr 293	February to November 1938.		91	18.6	8.1	1.4	24	7.8	30	184	
Duck River, above Columbia, Tenn.	TeD 247	February 1937 to February 1938.		1,575	17.4	8.7	1.6	80	7.7	140	120	120
Duck River, below Columbia, Tenn.	TeD 241	do		1,579	17.3	8.4	1.8	480	7.6	160	120	
Duck River, below Greenlick Creek.	TeD 233	do		1,782	17.3	8.3	1.6	350	7.6	190	122	
Big Bigby Creek, below Mount Pleasant, Tenn.	TeDBB 216	February to May 1938.		128	15.1	9.6	1.2	240	7.6		99	
Duck River, below Big Bigby Creek.	TeD 209	February 1937 to February 1938.		1,989	17.3	9.0	1.5	190	7.6	210	121	124
Duck River, above Centerville, Tenn.	TeD 193	do		2,273	17.2	9.0	1.6	120	7.6	220	115	
Duck River, below Centerville, Tenn.	TeD 175	February to November 1938.		1,959	20.2	8.4	1.4	170	7.6	220	107	
Piney River, below Wrigley, Tenn.	TeDP	do		202	18.5	8.5	1.4	100	7.6	40	106	
Duck River, below Piney River	TeD 143	do		2,470	20.1	8.5	1.8	95	7.6	140	104	
Buffalo River, below all wastes	TeDBu	do		985	20.4	8.3	.7	52	7.3	40	52	

[1] Duck River results made available through the joint cooperation of the State of Tennessee and the Tennessee Valley Authority.

FEB 5 1948

NATIONAL LIBRARY OF MEDICINE

NLM 00076812 8